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THESIS

POST-9/11 FIELD GRADE OFFICER REQUIREMENTS IN THE MARINE CORPS RESERVE

by

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March 2011

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The Reserve Affairs (RA) division at Headquarters Marine Corps (HQMC) requested the development of a model to determine affiliation and participation rates for field grade officers for a projected officer population in the Selected Marine Corps Reserve (SMCR) and the Individual Mobilization Augment (IMA) program, and a corresponding mobilization requirement among un-affiliated officers. This thesis analyzes roughly 20 years of Marine Corps Reserve officer inventory history. It examines how the Marine Corps Reserves current grade strength inventory evolved and uses that inventory data to develop a reference table for use by RA to better plan for future requirements. This table will allow RA to plan for how many of each field grade rank are required in inventory to maintain an acceptable manning rate so that the Marine Reserve is not left short-handed in those categories, or have too many under-employed officers.

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POST-9/11 FIELD GRADE OFFICER REQUIREMENTS IN THE MARINE CORPS RESERVE

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The Reserve Affairs (RA) division at Headquarters Marine Corps (HQMC) requested the development of a model to determine affiliation and participation rates for field grade officers for a projected officer population in the Selected Marine Corps Reserve (SMCR) and the Individual Mobilization Augment (IMA) program, and a corresponding mobilization requirement among un-affiliated officers. This thesis analyzes roughly 20 years of Marine Corps Reserve officer inventory history. It examines how the Marine Corps Reserves current grade strength inventory evolved and uses that inventory data to develop a reference table for use by RA to better plan for future requirements. This table will allow RA to plan for how many of each field grade rank are required in inventory to maintain an acceptable manning rate so that the Marine Reserve is not left short-handed in those categories, or have too many under-employed officers.

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LIST OF ACRONYMS AND ABBREVIATIONS

AC	Active Component
ADSW	Active Duty Special Work
ADT	Active Duty for Training
AR	Active Reserve
ASL	Active Status List
ASR	Authorized Strength Report
AT	Annual training
CNA	Center for Naval Analysis
DC M&RA	Deputy Commandant for Manpower and Reserve Affairs
DMDC	Defense Manpower and Data Center
DoD	Department of Defense
FY	Fiscal Year
FYDP	Future Years Defense Plan
GWOT	Global War on Terror
HQMC	Headquarters Marine Corps
IADT	Initial Active Duty for Training
IDT	Inactive Duty Training
IES	IRR Engagement Strategy
IMA	Individual Mobilization Augment
IRR	Individual Ready Reserve
ISL	Inactive Status List
JMD	Joint Manning Documents
M&RA	Manpower and Reserve Affairs
MARADMIN	Marine Administrative Message
MARFORRES	Marine Forces Reserve
MCMPS	Marine Corps Mobilization Processing System
MCO	Marine Corps Order
MCRAMM	Marine Corps Reserve Administrative Management Manual
MCTFS	Marine Corps Total Force System
MOBCOM	Mobilization Command
MOS	Military Occupational Specialty
MSO	Military Service Obligation
NDAA	National Defense Authorization Act

OIF	Operation Iraqi Freedom
OLS	Ordinary Least Squares
RA	Reserve Affairs
RAP	Reserve Affairs Personnel Plans and Policy
RASL	Reserve Active Status List
RC	Reserve Component
RCT	Reserve Counterpart Training
RDOL	Reserve Duty On-Line
SecDef	Secretary of Defense
SECNAV	Secretary of the Navy
SELRES	Selected Reserve
SMCR	Selected Marine Corps Reserve
SRIP	Selected Reserve Incentive Program
T/O	Table of Organization
TFDW	Total Force Data Warehouse
TFSMS	Total Force Structure Management System
UCMJ	Uniform Code of Military Justice
USMC	United States Marine Corps

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I. INTRODUCTION

A. PURPOSE

The salary and retirement costs associated with field grade officers cost more to maintain than other subordinate officer ranks, but significantly more than the enlisted ranks. To maintain more field grade officers than required in the Marine Corps Reserve means that it forgoes the opportunity to man enlisted personnel at authorized levels. For instance, one Colonel costs about the same as four Corporals. Table 1 illustrates the differences in annual reserve salaries, and how expensive it can be to maintain excess field grade officers in the inventory.

Officer	
$ 20,338.03	**Colonel (Col)**
$ 16,532.11	Lieutenant **C**olonel (Lt**C**ol)
$ 14,001.78	Major (Maj)
$ 11,361.50	**Captain (Capt)**
$ 8,467.21	**First Lieutenant (First Lt)**
$ 6,489.88	**Second Lieutenant (Second Lt)**
Enlisted	
$ 12,125.83	**Sergeant Major (SgtMaj)/Master Gunnery Sergeant (MGySgt)**
$ 9,774.93	**Master Sergeant (MSgt)**
$ 8,238.21	**Gunnery Sergeant (GySgt)**
$ 6,688.65	**Staff Sergeant (SSgt)**
$ 5,539.64	**Sergeant (Sgt)**
$ 4,608.83	**Corporal (Cpl)**
$ 3,803.05	**Lance Corporal (LCpl)**
$ 3,402.18	**Private First Class (PFC)**
$ 2,866.74	**Private (Pvt)**

Table 1. FY10 Annual Drilling Cost Per Grade

Since 9/11, the reserves have been in demand and on a regular activation schedule in support of the Global War on Terror (GWOT). In addition, Joint Manning Documents (JMD) levy unstructured manpower requirements on the Marine Corps by the Secretary of Defense (SecDef) which may be sourced via Reserve manpower. The perceived surpluses against the perceived requirements fuel the debate between what the Marine Corps requires based on structure and authorizations, and truer requirements based on operational tempo. The Marine Corps Authorized Strength Report (ASR) allocates manning to units by grade and Military Occupational Specialty (MOS) based on what is afforded within the manpower budget. At the end of Fiscal Year (FY) 2010, the actual number of on-hand Selected Reserve (SELRES)[1] members reflected a deficit of field grade officers[2] (Table 2). (FY10 actual data provided to author by Manpower and Reserve Affairs (M&RA), October 2010.)

Rank	ASR[3]	FY10 Actual	Delta
Colonel	292	276	-16
Lieutenant Colonel	755	971	216
Major	1760	933	-827

Table 2. SELRES ASR vs. FY10 SELRES Actual

The different perspectives on excesses vs. requirements lead to the questions: What inventory does the Marine Corps require for Reserve field grade officers in the post-9/11 era to maintain acceptable affiliation and participation levels in accordance with Table of Organization (T/O) and mobilization requirements? And is the number of Reserve Component field grade officers currently over or undermanned? The Reserve Active Status List (RASL) is a by-name list of all officers (excluding warrant officers) in each respective armed service who are in an active status in a Reserve component and are

[1] Reserve Structure will be discussed in detail in Chapter II.

[2] A Field Grade Officer includes the ranks of Colonel (Col), Lieutenant Colonel (LtCol), and Major (Maj). Company Grade Officers include Second and First Lieutenant and Captain (Capt).

[3] ASR Data provided by Reserve Affairs Branch, Headquarters Marine Corps, Quantico.

not on the Active Duty List. The RASL includes those officers who are a part of the Selected Reserve (SELRES), the Individual Ready Reserve (IRR), and the Active Status List (ASL), which will all be discussed in Chapter II. This research examines the number of field grade officers, by grade, required on the RASL to man Selected Marine Corps Reserve (SMCR) unit and Individual Mobilization Augment (IMA) requirements, and support mobilization needs. Lastly, this research estimates affiliation and participation levels as a function of grade strength. Affiliation and participation will also be discussed in more detail in Chapter II.

The goal of this study is to analyze approximately twenty years of Reserve Component (RC) officer grade strength history, discuss how the RC arrived at their existing inventory, and ultimately determine the inventory levels to meet structure and mobilization requirements. This research examines how to determine and model future inventory requirements for RC field grade officer grade strength in order to better meet acceptable affiliation and participation rates to man the IMA and SMCR units. It examines whether the RC is currently over or undermanned in the field grade officer ranks, and adequately staffed at those ranks to meet activation requirements.

B. BACKGROUND

In 1990, Defense Secretary Cheney faced the decision of whether or not to activate reserve soldiers, sailors, airmen, and Marines for the first time since the Vietnam War,[4] and since Desert Storm, the Marine Corps Reserve has activated quite extensively. Now in a post-9/11 era the Marine Reserve continues to activate and deploy with great success, particularly since the beginning of Operation Iraqi Freedom (OIF) in 2003. Figure 1 shows the activation trends of SELRES Marines since 2001 and peaking in 2003 at over 17,800 individual activations. An average of almost 7,000 SELRES Marines per month have served on active duty since 2001 and presently carries approximately 8,000 Marines on active duty. (Figure 1 data provided to author by M&RA, October 2010.)

[4] M. Moore, Pentagon May Request Activation of Reserves. Washington Post, A33, (August 16, 1990).

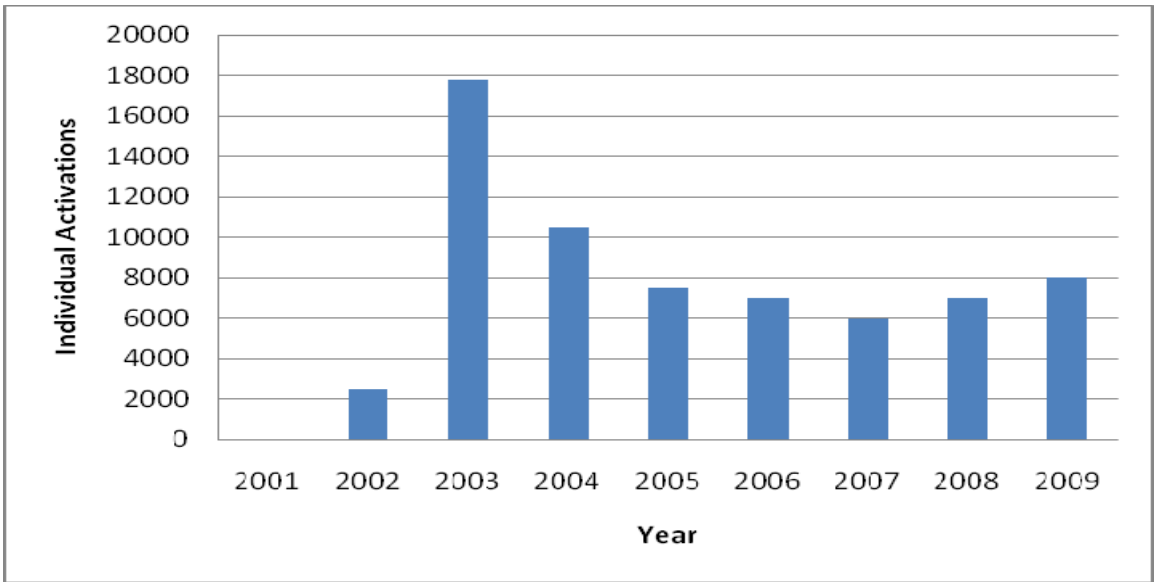

Figure 1. Individual SELRES Activations Since 2001

After Desert Storm, there was a continuing post-Cold War draw down of active duty officers that saw promotion and augmentation[5] rates at their lowest levels in years.[6] In the early to mid 1990s, the promotion rate from Captain to Major was in the high 60 percent range. When a company grade officer fails selection twice to the next higher grade, he is discharged from active duty typically within the year. Many officers who were not selected or augmented during this period transferred to the SELRES to continue their involvement with the Marine Corps. The Marine Corps Promotion Manual states that:

> Failures of selection do not carry over between competitive categories (i.e., active duty failures do not carry over to the Reserve component). Once an officer has failed of selection in one competitive category, that failure of selection is maintained in that competitive category only.[7]

[5] Naval officers are initially commissioned in Reserve status. Prior to the end of their initial contract, they transition to regular officer status provided they meet the requirements for appointment as a regular officer under Section 532 of Title 10, U.S. Code.

[6] C. McHugh, Analysis of the Marine Corps Manpower System. Alexandria, VA: Center for Naval Analysis (2006).

[7] Marine Corps Order (MCO) P1400.31C, para 4002.3.

Once an officer transfers from active to the reserve component, his promotion record has a clean slate and can continue to compete for promotion among his new reserve counterparts.

By FY01, the promotion rate to the rank of Major had reached 85 percent and continued to climb to nearly 89 percent during OIF I (Figure 2). (Figure 2 data provided to author by Officer Plans Section, Manpower Plans Programs and Budget Branch, Manpower Plans and Policy Division, and M&RA, October 2010.) Those lower promotion rates observed during the early 1990s resulted in a surge of company grade officers into the RC that the Marine Corps now sees as an excess of field-grade officers against the RC ASR.

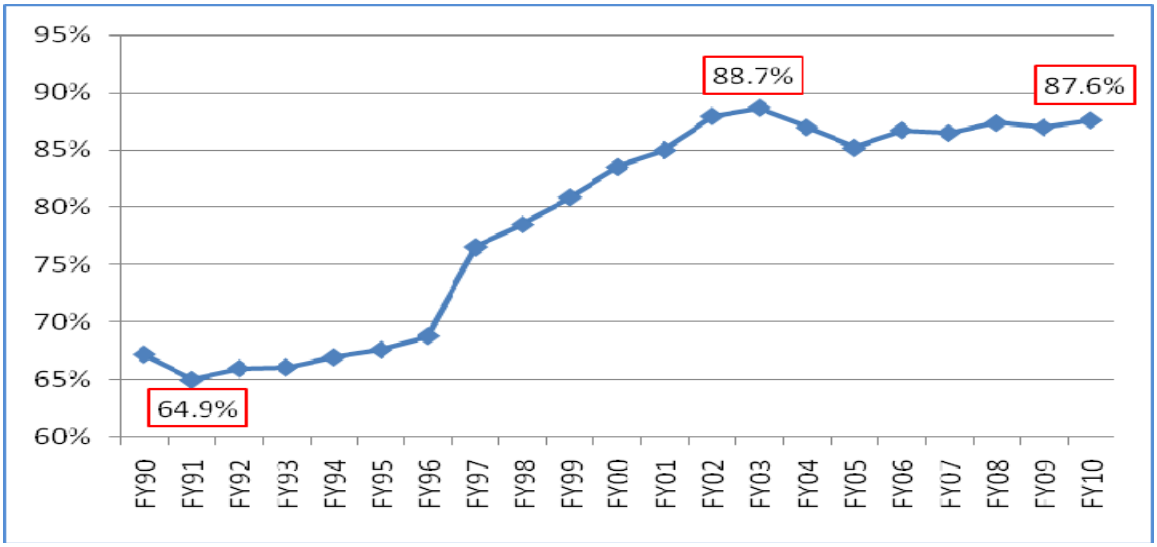

Figure 2. Active Component (AC) Selection Rate to Rank of Major

As depicted in Figure 3, the desire to reduce the Active Component (AC) officer strength was successful during the first half of the 1990s, while Captains had to compete for promotion under the challenge of such low selection and augmentation rates. This, however, led to a "bubble" in the RC as a glut of officers entered and promoted through the reserves. Figure 3 shows a noticeable inverse relationship between AC and RC growth and reduction. Whether these patterns can be applied to just the field grade officer, is indeterminate. (Figure 3 data provided to author by M&RA, October 2010.)

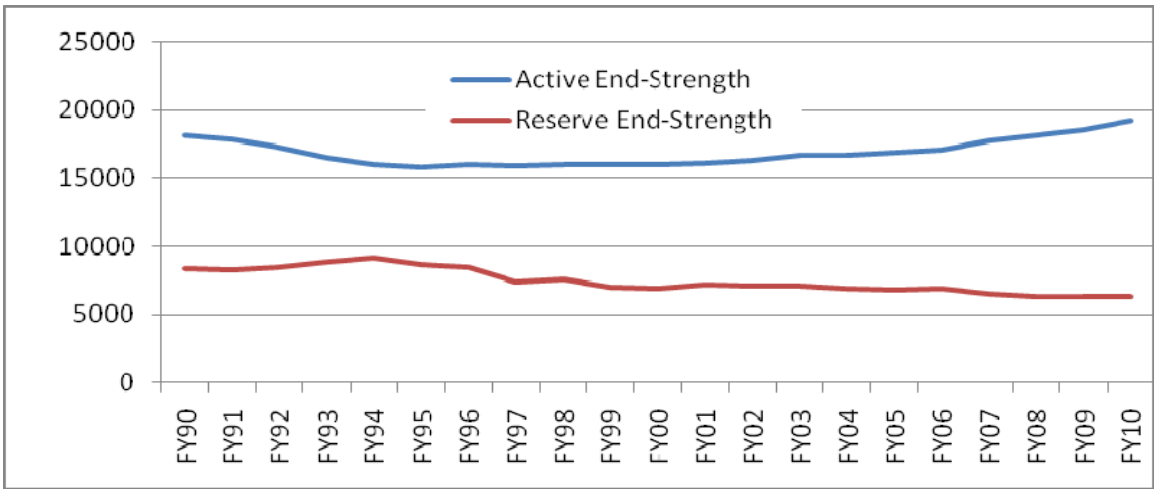

Figure 3. AC and RC End-Strength FY90 to FY10 (Second Lt through Colonel)

To further illustrate the point as to how field grade officer end strength is where it is today, Figure 4 provides a glimpse into the progression of officer promotions and how this period of time affected future field grade end strength. (Figure 4 data provided to author by M&RA, October 2010.) As the influx of company grade officers entered the reserve in large numbers from 1992 to 1994, their promotion to field grade approximately six years later is consistent with increases in the field-grade officer numbers further through the timeline beginning around the FY98 period.

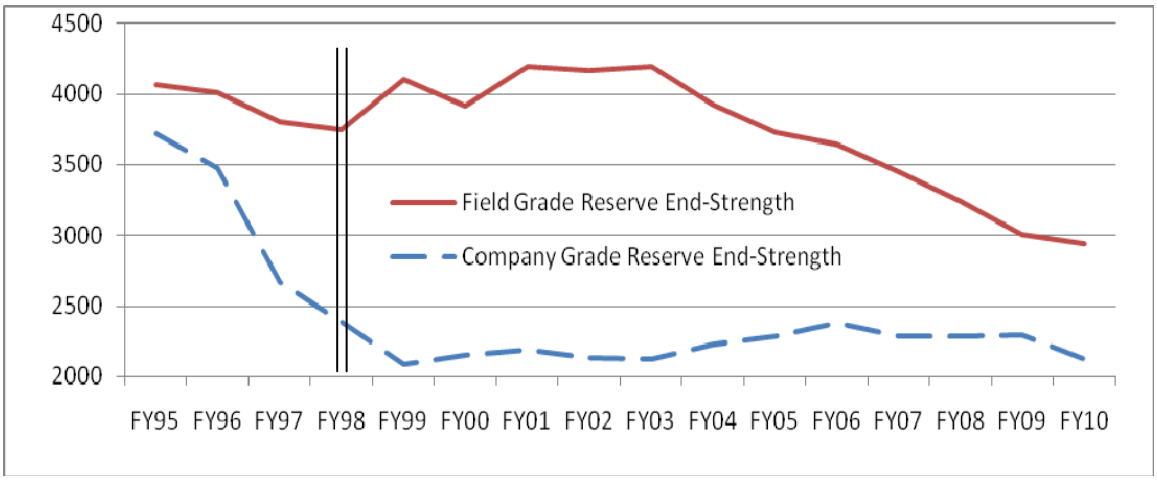

Figure 4. RC Company and Field Grade End-Strength FY95–FY10

In 2008, the Deputy Commandant of Manpower and Reserve Affairs (DC M&RA) and the Reserve Affairs (RA) division released a message, as well as letters personally addressed to all reserve Colonels asking for voluntary retirement due to an overage of Colonel's in the reserve. If the desired end-state was not achieved through requests for voluntary retirement, a series of screening and statutory boards determined whether or not an individual would be discharged or go through some other change in status. This particular process will be discussed in more detail in Chapter II.

C. SCOPE AND METHODOLOGY

The RA division at Headquarters Marine Corps (HQMC) currently uses a 10-year forecasting model for officer end-strength. Future planning requirements now calls for the development of a model to determine affiliation rates for field grade officers for that projected officer population in the SMCR and IMA. In other words, how many field grade officers of each grade are needed in inventory to maintain an acceptable manning rate so that the Marine Reserve is not left short-handed in those categories, or have too many officers under-employed? This study will review all subject documentation, analyze historical trends, and develop a descriptive model based on historical data for future officer requirements that estimates affiliating and participating inventories to determine an overall inventory that meets requirements.

The methodology will include both qualitative and quantitative research. Qualitative methods will include an analysis of the ASR and RASL; a review of the National Defense Authorization Act (NDAA) and Title 10 legislative history; and a review of T/O requirements. Quantitative methods will include an analysis of historical manning and affiliation rates from TFDW; historical affiliation and participation rate analysis and evaluation of the current T/O requirements, and the development of a reference table to plan for future inventory requirements.

D. ORGANIZATION OF STUDY

Chapter II examines the Marine Reserve structure as it applies to field grade officers, and discusses portions of the NDAA, Title 10, and other legislative history, USMC Manpower history, and current T/O structure. Chapter III is a literature review

that discusses limited prior research on Marine Corps Reserve manpower issues. Chapter IV presents the data, methodology, analysis, and model development. It specifically discusses the data and variables used in the model, and presents the results of the data analysis within a developed model. Chapter V presents the summary, conclusions, and recommendations.

II. RESERVE ORGANIZATION AND STRUCTURE

A. INTRODUCTION

The Marine Corps Reserve Administrative Management Manual (MCRAMM) states that "The mission of the Reserve Component (RC) of the Marine Corps Total Force is to augment and reinforce the Active Component (AC) with trained units and qualified individuals in a time of war or national emergency, and at such other times as national security may require."[8] It goes on to say about the RC mission:

> The Marine Corps Reserve complements the Marine Corps operating force structure and capabilities. Charged with providing the means for rapid expansion of our Corps during national emergency, the Marine Corps Reserve provides the added capability, flexibility, and depth that are the foundation for our sustainment at any level of recall or mobilization. Total Force integration is the dominant theme for all Reserve planning, training, and administration.[9]

The Deputy Commandant for Manpower and Reserve Affairs (DC M&RA) is the principal staff officer and works directly for the Commandant of the Marine Corps to "organize, administer, train and equip" the RC forces.

> The Deputy Commandant for Manpower and Reserve Affairs (DC M&RA) is the principal staff officer for Reserve manpower matters and is directly responsible for the formulation of plans, policies, budget, structure, and administration of the RC. This is accomplished through the development and promulgation of unique policies, procedures, and guidance to administer the RC within the Total Force construct.[10]

B. COMPONENTS

The three major components of the Marine Corps Reserve are the Ready Reserve, Standby Reserve, and Retired Reserve and are shown in Figure 5. After discussing all elements of the Reserve Active Status List (RASL), to help give a broader perspective for the purposes of this study in dealing with field grade officers, the focus is on just the

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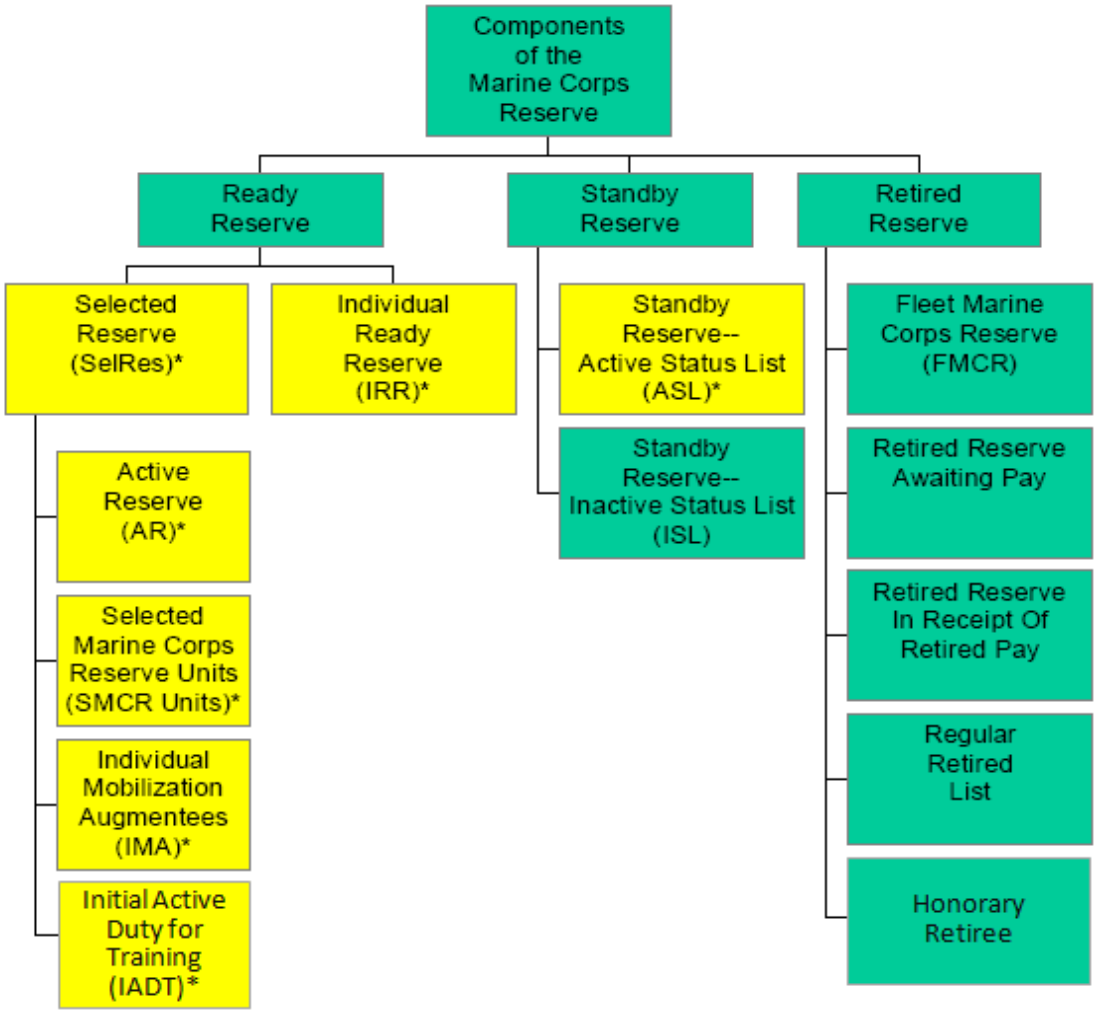
[8] MCO 1001R.1K, Ch 1 para 1100.

[9] Ibid.

[10] MCO 1001R.1K, para 4.b.1.b.

Selected Marine Corps Reserve (SMCR) units and the Individual Mobilization Augment (IMA) program. No field-grade officers exist in Initial Active Duty for Training (IADT) as typically only Second Lieutenant's fall in this category. The Active Reserve (AR) is considered active duty and controlled by separate statutory authority that is consistent with structure requirements, and is not an issue with field-grade excess.



Note: Components highlighted in yellow (*) are elements of the RASL.

Figure 5. Components of the Marine Corps Reserve[11]

[11] MCO 1001R.1K, Figure 1-1.

1. Ready Reserve

Included under the Ready Reserve are the Selected Reserve (SELRES) and the Individual Ready Reserve (IRR). The Ready Reserve consists of both units and individuals who are trained and ready for immediate recall to active duty in a time of war or national emergency, or for any other reasons outlined in Title 10. This represents the bulk of the Marine Corps Reserve available for immediate activation.

a. Selected Reserve

The Selected Reserve is comprised of those that have an Inactive Duty Training (IDT), Active Duty for Training (ADT) or active duty obligation and those that have completed their obligation and continue to serve voluntarily. These obligations include regularly scheduled training periods such as weekend drilling, two week annual training, or any other training prescribed by a Marine's respective unit that would allow him/her to acquire the minimum annual points for satisfactory performance.

(1) Active Reserve (AR). The AR program consists of those reservists in a full-time active duty capacity in support of the reserve forces. The AR facilitates organizing, recruiting, retention, administration, and training of the Marine Corps Reserve. At the end of FY10, the AR consisted of 10.8 percent of the total field grade officer strength in the SELRES (Table 3). (Table 3 data provided to author by M&RA in October, 2010.)

(2) Selected Marine Corps Reserve (SMCR). Individuals belonging to the SMCR are attached to organized units. These units typically mirror infantry, aviation, and logistics AC units. They belong to 4th Marine Division (4th MarDiv), 4th Marine Air Wing (4th MAW), 4th Marine Logistics Group (4th MLG) and other Force level units of Marine Forces Reserve (MARFORRES). The number of field grade officers within the SMCR accounted for 35.3 percent of the total SELRES at the end of FY10 (Table 3).

(3) Individual Mobilization Augment (IMA). Members of the IMA are those individuals who drill regularly as those in the SMCR, but are not assigned to an SMCR unit. Rather, they are assigned to an AC billet to meet mobilization

requirements, and drill with their AC unit. The IMA tour length is three to five years barring any approved extensions, at which point the individuals are transferred to the IRR, SMCR unit, or another IMA. A majority of reserve field grade officers, 53.8 percent of the total SELRES, was enrolled in the IMA at the end of FY10 (Table 3).

	FY10 SELRES		
RANK	SMCR	AR	IMA
Colonel	102	32	174
Lieutenant Colonel	349	100	622
Major	414	133	519
Grand Total	865	265	1315
% of SELRES	35.3%	10.8%	53.8%

Table 3. FY10 SELRES Grade-strength

b. Individual Ready Reserve (IRR)

The second component of the Ready Reserve is the IRR. The IRR is a pool of trained Marines ready for mobilization containing those that were previously on active duty or obligated to drill in the SELRES and have completed their contractual obligation to serve on active duty or drill. These Marines belong to the IRR by way of voluntary assignment, or due to having not completed their Military Service Obligation (MSO)[12]. There is no drilling requirement. There were 726 field grade officers in the IRR at the end of FY10.

Figure 6 breaks down the four major components of the reserves as it applies to FY10 field grade officers. It shows that the SMCR and IMA represent the two largest sub-components and is the focus of reserve affiliation rates. (Figure 6 data provided to author by M&RA, October 2010.)

[12] Service requirements are detailed in U.S. Code 10, §651.

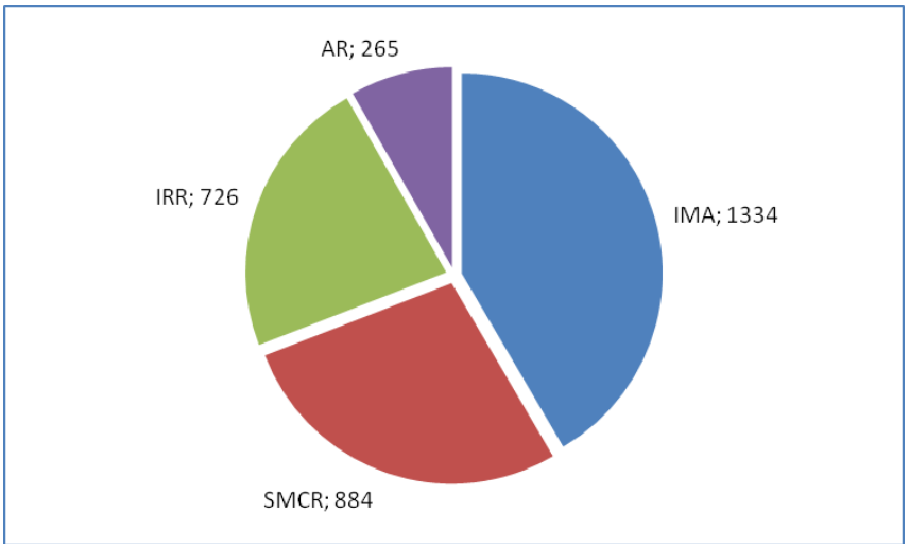


Figure 6. Total FY10 Ready Reserve Field Grade Officer Assignment

2. Standby Reserve

The Active Status List (ASL) is a sub-component of the Standby Reserve and is also part of the RASL. This list consists of Marines who are in an active status for purposes of promotion and are eligible to participate in reserve training programs for retirement point credit only, but who may intend to return to the Ready Reserve. ASL Marines are in active status with no requirement to train, do not draw a paycheck, and can be recalled as necessary to fill any manpower requirements. Some are designated as key federal employees such as members of Congress and are also eligible for regular promotion. As of the end of FY10, field grade officers on the ASL totaled only 10 officers (data provided to author by M&RA, October 2010).

C. AFFILIATION

Members of the SMCR, IMA, and AR are said to be "affiliated" with the SELRES. If they do not belong to any of those sub-components, they otherwise belong to the IRR or ASL. The "affiliation rate" refers to the ratio of officers in the SELRES filling an SMCR or IMA billet to the total number of officers in the RASL, which includes the large IRR portion. Ideally, the desired affiliation rate is no less than 90 percent, but historical data will show this to be a difficult mark to reach. Table 4 shows

FY10 grade strength, broken out by sub-component, and the resulting affiliation rate by rank. (Table 4 data provided to author by M&RA, October 2010.) The comprehensive affiliation rate of all field grade ranks combined at the end of FY10 was 75 percent. This implies that 25 percent of RASL members, while not being paid in the IRR, continue to promote and collect retirement points. Adding more officers only creates a greater well of inventory for mobilization, decreasing the affiliation rate even further. It is this low rate of affiliation that is of concern to Reserve Affairs and what this research will focus on while developing an affiliation rate reference table, to plan for future field grade officer grade strength to meet mobilization requirements.

	Colonel	Lieutenant Colonel	Major	
SMCR	110	355	419	
IMA	182	628	524	Total
Sub-Total	292	983	943	2218
IRR	142	226	358	
ASL	7	3	0	Total
TOTAL	441	1212	1301	2954
	AFFILIATION RATE			Total
	66%	81%	72%	75%

Table 4. FY10 Affiliation Rates

Since 1995, the respective affiliation rate for the field grade ranks has fluctuated within a 20 percent window–roughly 50 to 70 percent for Colonels, 60 to 80 percent for Lieutenant Colonels, and 50 to 70 percent for Majors. Chapter IV, Data and Methodology, will later graphically depict the inverse relationship between affiliation and total inventory.

D. BINDING POLICIES AND DOCUMENTATION

As with the regular active military, several congressional governing documents, as well as Marine Corps orders, policies, and tables of organization govern the size, end strength, use of, and activation of the Marine Corps Reserve. This section will analyze these sources, participation requirements, and activation authorities.

1. Participation Requirements

Each member of the Marine Corps Reserve is required to attain a minimum amount of participation credit to achieve a satisfactory year. Inactive Duty for Training (IDT) is the regular weekend drilling requirement. Each period, or drill, represents a 4-hr block, so a weekend drilling period would equate to four drills (four points). As a result, 48 drills equates to one weekend a month in most cases. Annual Training (AT) is the two-week active duty requirement each year and each of those periods represent one full work day (one point per day). Members of the Selected Marine Corps Reserve (SMCR) and Individual Mobilization Augment (IMA) are required to achieve 48 drills for the year, and 14 and 12 days respectively for AT. This results in 62 annual points for SMCR and IMA Marines completing the minimum drills. Twenty-seven points is the minimum required to remain in the Individual Ready Reserve (IRR) for a Marine under 20 years of service. However, fifty points must be earned to qualify as a year toward retirement for SMCR, IMA, and IRR. Individuals over 20 years of service must acquire a minimum of 50 points annually to remain enrolled in the IRR or be transferred to the Retired or Standby Reserve, or be discharged (Table 5).

Members of the Ready Reserve earn 15 automatic points for enrollment. IRR members accumulate additional points through various sources to include drilling without pay, volunteering to perform Reserve Counterpart Training (RCT), short tours of active duty, exercise support, correspondence courses, or mobilization. Active Reserve (AR) Marines are not subject to minimum point requirements as they are on Active Duty.

Category	IDT	ADT	Points	Retirement	Other
SMCR	48	14	N/A	50	
IMA	48	12	N/A	50	
IRR	0	0	27	50	Muster Duty
AR	N/A	N/A	N/A	N/A	Active Duty

Table 5. Minimum Participation Requirements for Reserve Marines[13]

Along with meeting the minimum participation requirements, Reserve Marines in Active status are also subject to regular USMC height and weight standards and the Uniform Code of Military Justice (UCMJ). Failure to meet these requirements is grounds for discharge from the Reserve or result in transfer to the Inactive Status List (ISL).[14]

2. Activation

Certain laws detail all activation authorizations. The Code of Laws of the United States of America contains general and permanent federal laws of the United States. Title 10 of the U.S. Code reflects laws passed by Congress as they pertain to the U.S. military, and Subtitle E, Part II deals in general with military reserve personnel. Any Marine reservist with the exception of Honorary Retirees can be lawfully activated under several Title 10 authorizations. The following Title 10 sections apply:

- 12301a – involuntary activation of reservists in general, for the duration of the conflict plus 6 months thereafter, unlimited amount of personnel, requires declaration of war by Congress.
- 12301d – voluntary active duty orders during periods of peacetime or national emergency.

[13] MCO 1001R.1K, Table 9-1.

[14] Officers on the ISL belong to the Standby Reserve, and are not required to remain in an active status but retain their Reserve commission and can be recalled to Active Duty if necessary.

- 12302 – involuntary activation of a reservist in time of national emergency, 24 month duration, limited to 1 million personnel, requires Executive Order declaring the national emergency.
- 12304 – involuntary activation of reservists for an emergency deemed necessary other than war or national emergency, 365 day duration, limited to 200 thousand personnel (30 thousand from the IRR), Executive Order declaring contingency.

3. End Strength Authorizations

a. National Defense Authorization Act (NDAA)

The NDAA is the annual legislation passed by both houses of congress and signed by the President that authorizes funding for the Department of Defense (DoD) each fiscal year. Since FY04, NDAA has authorized the total reserve manpower end strength at a constant 39,600. As seen in Figure 7, after a peak in FY91, with the conclusion of Desert Storm, and with the continuing post-Cold War draw down of forces, the total reserve force was reduced by nearly ten percent.

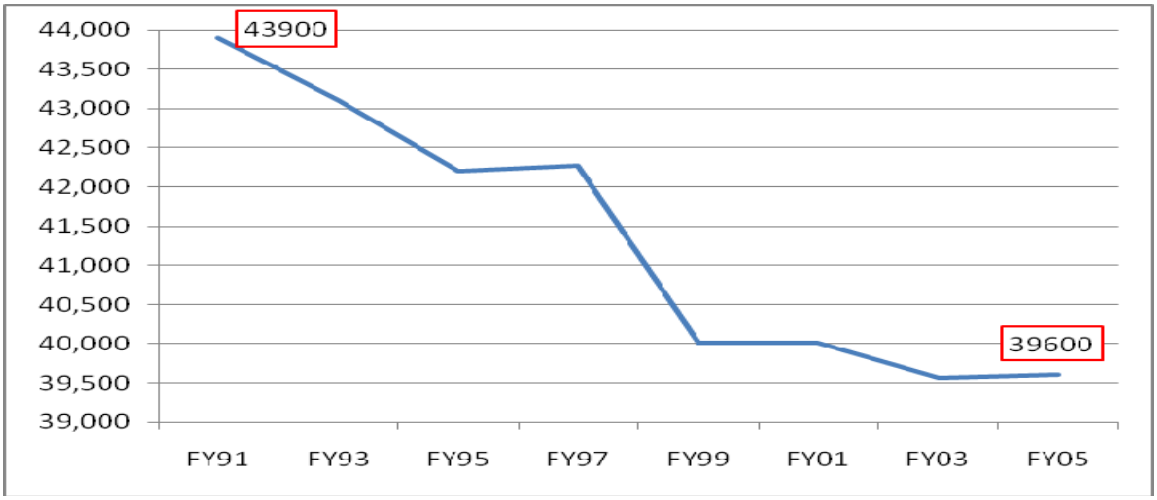


Figure 7. NDAA Reductions in Total Reserve Force End Strength[15]

[15] *The Library of Congress.* (1990–2010). Retrieved December 15, 2010, from http://thomas.loc.gov/.

b. U.S. Code Authorization

The 10 U.S.C. goes further than the NDAA and addresses officer levels at each rank. Section 12003 limits the authorized strength of Marine Corps Reserve officers in an active status at 24,500 officers. The 10 U.S.C., § 12005 further authorizes each specific grade as a percentage of the total authorized number of officers. The 10 U.S.C., §12006 grants authority to the President to "suspend the operation of any provision of section 12003…or 12005" for the duration of the war or national emergency. At the end of FY10, the grade strength of each field grade rank was within the statutory limitation (Table 6). (Table 6 data provided to author by M&RA, October 2010.) (Recall that the Reserve Active Status List (RASL) includes the entire SELRES, IRR, and ASL.)

Reserve Active Status List (RASL) Authorization - 24,500 officers

Rank	% RASL	Authorized	FY10 Actual	Delta
Colonel	2%	490	466	-24
Lieutenant Colonel	8%	1960	1225	-735
Major	16%	3920	1434	-2486

Table 6. RASL Authorization vs. FY10 Actual

4. Attempts to Reduce the Colonel Population

In 2008, the Deputy Commandant of Manpower and Reserve Affairs (DC M&RA) released a Marine Administrative Message (MARADMIN) addressing the overage of reserve Colonel's (MARADMIN 122/08) in order to realign the Reserve Colonel population within statutory limits. At the time, there was an overage of 158 Colonel's above the RASL limitations and needed to comply with those limits by February 2010[16] (Figure 8). (Figure 8 data provided to author by M&RA in October, 2010.) It outlined four courses of action to meet these requirements: 1) requests for voluntary retirement; 2) one-time waivers for those who failed to meet the minimum

[16] Secretarial waiver was set to expire in February 2010.

annual requirement for retirement credit; 3) mobilization potential screening board to discharge those who lack future activation potential; and 4) selective early removal board, in the event the previous three methods proved to be ineffective. The board would then identify those to be removed from the RASL based on guidance set by the Secretary of the Navy (SECNAV).

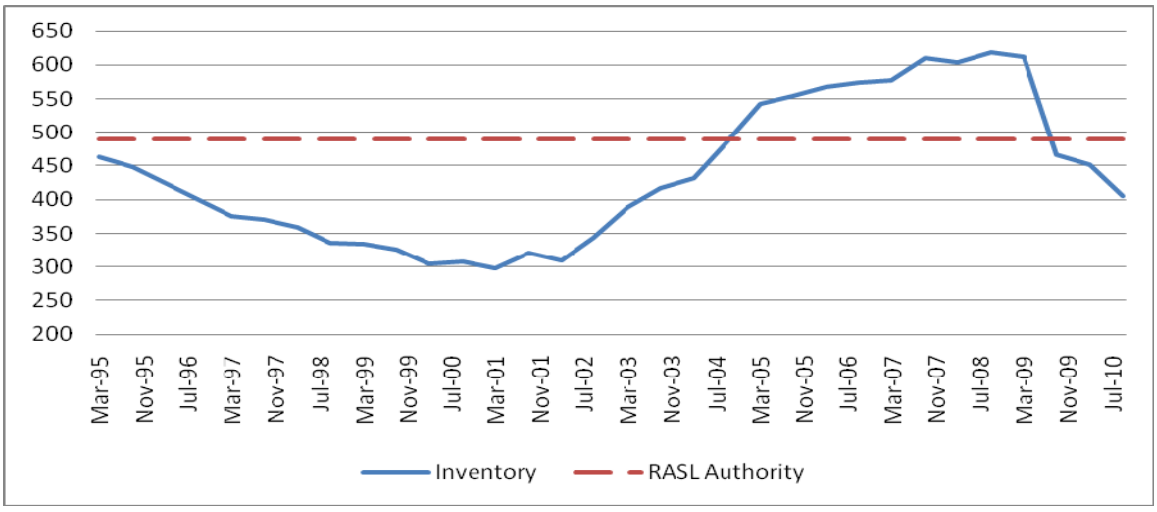


Figure 8. Colonel Inventory Against RASL Authority

Following the release of this message, the DC M&RA sent a letter to all reserve Colonels, stressing the importance of the voluntary retirement option so that the Marine Corps could meet its mandated limit and to ensure that junior officers would have sufficient opportunity to pursue further career opportunities, and so that others behind them could select for Colonel later on in their own careers. Later that year, the Reserve Affairs Personnel Plans and Policy (RAP) branch head sent another letter to all Colonels stating that the lack of response to the request for voluntary retirements since the release of both the message and the DC M&RA letter would result in a Selective Early Removal Board the following fiscal year. As a result, 99 Colonels were involuntarily removed from the RASL. The result was that by the end of FY10 the amount of Colonels on the RASL had been reduced by over 200 officers and the grade strength within limits at 466 colonels as seen in Table 6.

5. T/O and ASR

The Marine Corps Table of Organization (T/O) lists the standard "requirement" for every authorized billet by rank and Military Occupational Specialty (MOS), fulfilling necessary duties for each specific type and size of unit. The T/O provides an "ideal" inventory of what each unit requires to accomplish their mission if there were no budget constraints. The overall grade strength was less than the T/O, with only Lieutenant Colonel exceeding the limit as shown in Table 7. (Table 7 data provided to author by M&RA, October 2010.)

Rank	SELRES T/O	FY10 Actual	Diff
Colonel	339	276	-63
Lieutenant Colonel	967	971	4
Major	2360	933	-1427

Table 7. SELRES T/O vs. FY10 Actual

After the T/O determines the ideal requirement for each unit, budget constraints are then considered. The ASR, excluding contingency structure, allocates what can be theoretically "bought" for each unit. For instance, the T/O may require that a unit carry two Lieutenant Colonels and four Captains. Based on ASR budget constraints, they can only afford a lesser combination of those ranks. For example, that unit can "buy" one Lieutenant Colonel and all four Captains, or two Lieutenant Colonels and only two Captains.

E. CHAPTER SUMMARY

Reserve structure is complicated and non-linear relative to active duty, yet flexible and highly adaptive to the needs of the nation's defense. This chapter provides a macro view of the Marine Corps Reserve organization. It also provides a statistical analysis of where the field grade officer resides within the Marine Corps Reserve and the issues regarding end strength, grade strength, participation requirements and rates, and affiliation rates.

III. LITERATURE REVIEW

A. PRIOR RESEARCH

Prior research on Marine Corps Reserve Manpower in general is scarce, and even more so regarding field grade officers. No prior research was found on Marine Corps Reserve affiliation or participation rates, but a few studies do address other manpower issues that relate to sub-topics of this thesis. The studies found were prior Navy Postgraduate School (NPS) theses, a Center for Naval Analysis (CNA) study, and a Masters Research Paper from the Marine Corps Command and Staff College.

1. An Analysis of the Marine Corps Reserve Appropriations (1960–1999)

In this NPS thesis (1993), Taylor compares the budgets of the Active Marine Corps against the Reserve Marine Corps to analyze how the reserves faired during the 1960s Cold War period through the post-Cold War era of the early 1990s. This period saw spikes in DoD budgeting during the 1980s to the aggressive drawdown in the early 1990s. It specifically analyzes data on end strength and personnel funding broken down by each decade. Data was obtained through Congressional Budget information from fiscal years 1960 through 1994, Future Years Defense Plan (FYDP), CNA studies, the RAND Corporation, and the Marine Corps Research Center.

The Taylor study ultimately shows that the funding patterns for the active and reserve components were mostly similar, with two exceptions. The Vietnam War showed massive increases to the active components, with steady funding of reserve components. During the early 1980s Reagan build-up, the reserve components received greater rate increases than the active components.[17]

The Taylor data reinforces the findings of this research as it applies to the early 1990s period of decreased budget policies. It supports the data regarding Reserve end strength during the early 1990s drawdown period. However, the Taylor study also notes

[17] M. Taylor, An Analysis of the Marine Corps Reserve Appropriations (1960–1999). Monterey, CA. (1993).

that maintaining manpower for the reserves is significantly less expensive than active duty, so it also supports the claim that while the Reserve budget decreases, it could still support increases in end strength.

2. Forecasting Retention in the United States Marine Corps Reserve

In this NPS thesis (2005), Schumacher uses logistic regression analysis to predict individual Marine responses to wartime activation levels. Using data from the Bureau of Labor and Statistics, and the Defense Manpower and Data Center (DMDC), he establishes probabilities of retention based on occupational fields and unit locations. The results yield an interesting trend as it pertains to manpower end strengths during a period of war.

In general, retention remained very high during war time periods. The effects of mobilization to active service were positive in the retention of Reserve Marines. More specifically, those in the Standby Reserve and Ready Reserve were also shown to re-enlist at more frequent rates. This was attributed in his study to the idea that when an individual joins the Marine Corps Reserve, that individual has shown a desire to serve their country when called to duty.[18] Therefore, the results show that although living the life of a civilian after all the training, and perhaps prior active duty time, there tends to be a desire to be a part of a deploying force.

In contrast, however, the longer a reservist is on active duty orders, the more likely they are to not re-enlist. The logic being that if they wanted to remain on active duty for extended periods, they would have chosen to go active in the first place. The more frequent the activations, and the longer those activations were, retention rates dropped.

Finally, the Schumacher study analyzes retention rates of those based on the economic climate of their home of record. It supports the hypothesis that retention in the Marine Corps Reserve would remain higher among individuals who live in areas where they may have a more difficult time finding employment.

[18] J. F. Schumacher, Forecasting Retention in the United States Marine Corps Reserve. Monterey, CA. (2005).

The Schumacher study supports the data in this research that shows excesses in reserve field grade officer manpower as a result of the desire to be a part of active duty for limited periods of time during post 9/11 conflicts. It also may help explain why there was difficulty looking for voluntary retirements in 2008 during a period of a declining economy from about 2005 to present.

3. SELRES Attrition and the Selected Reserve Incentive Program in the Marine Corps Reserve

This CNA study (2006) focuses on the effect of the Selected Reserve Incentive Program (SRIP) on attrition in both the enlisted and officer ranks of the SELRES. Within the study, it details the movement of active duty Marines from September 1997, to June 2005. During this period, 7,045 officers separated from active duty, of which 47 percent joined the Marine Corps Reserve. Over 90 percent of those then went directly to the IRR. Further analysis revealed that as of August 2005, 46 percent were still in the IRR, while another 40 percent transferred to another component of the Reserve. Of the 40 percent, 77 percent of those officers went to an SMCR unit or joined the IMA, 22 percent went to the Standby Reserve, and two percent went to the Active Reserve.[19]

The study determines the relationship between how long an officer was in the IRR before affiliating with some other component of the Marine Corps Reserve. Between 40 and 60 percent of officers in the rank of FirstLt through Lieutenant Colonel spent less than 6 months in the IRR. Only ten percent of those who spend more than 30 months in the IRR affiliate somewhere else. It was evident that the longer one spends in the IRR, the less likely they are to affiliate with the other organized components of the reserve. More important to note as it relates to this thesis, it was also found that after the first six months in the IRR, field grade officers were less likely to leave the IRR and affiliate with the SELRES by 10 percent over Captains, and 20 percent over First Lieutenants.

[19] A. Parcell, and A. Hattiangadi, *SELRES Attrition and the Selected Reserve Incentive Program in the Marine Corps Reserve.* Alexandria, VA: Center for Naval Analysis (2006).

This CNA study also reveals survey results that show the longer one deploys or is on active duty orders; the less likely they are to affiliate with a SELRES component of the Marine Corps Reserves. This supports the analysis from the previous Schumacher study.

4. Analysis, Design, and Implementation of a Logical Proof-of-Concept Prototype for Streamlining the Advertisement of Billets for the Marine Corps Reserve

The Reserve Duty Online (RDOL) is a tool that provides Active Duty and Reserve Marines the ability to search and apply for available SMCR, IMA, and Active Duty Special Work (ADSW) billets. This NPS thesis (2008) addresses some issues with the current RDOL system and developed a prototype system to replace RDOL to better help Marines search for billet opportunities to allow them to remain employed and further their career with the SELRES.

Some of the issues they noted were problems with search functionality, non-operational functionalities, redundancy of operations, no option to post resumes, no option for employers to seek out candidates, and re-directs off the page to external links with no way of returning to RDOL. The authors argue that having these issues with the primary online source of reserve recruiting is a serious detriment to individual Marines seeking employment within the SELRES and hurts the entire Marine Corps Reserve as billets are becoming more and more difficult to fill with the right person at the right time. They concluded:

> In the midst of the long war, it is clearly evident that the reserve is an integral part of the Marine Corps total force. This integration hinges on the recognition that the ability for our reservists to be able to easily search and identify available opportunities is of the utmost importance. Additionally, it is equivocally important for employers to have those same abilities to seek out potential reservists to fill various types of reserve billets. The current manpower struggles the Marine Corps faces requires that we do our best to put our reserve Marines in the right billets at the right time.[20]

[20] J.D. Mohler and J.M. Thorpe, Analysis, Design, and Implementation of a Logical Proof-of-Concept Prototype for Streamlining the Advertisement of Billets for the U.S. Marine Corps Reserve. Monterey, CA. (2008).

This information regarding the current RDOL system could be a contributing factor in the low affiliation rates, as many IRR Marines currently looking for work may simply not be doing so due to user interface difficulties. This study provided no data on how many potential recruits may have been lost due to RDOL user issues, but while there are other means of looking for work in the reserves, such as visiting a recruiter station, the dependence on online resources cannot be underestimated.

5. Reassessing the Individual Ready Reserve's Roll in the Marine Corps Total Force

This report submitted for a Master of Military Studies at the Marine Corps University Command and Staff College (2008) argues that the IRR is misused and underutilized. In this study, Shinskie discusses the IRR Engagement Strategy (IES) implemented in 2005. The IES outlined specific goals to better use the IRR as an operational force. Those goals included increasing IRR reenlistment rates, increase the ability to contact IRR Marines, and decrease the number of Marines unqualified for mobilization. While IES had measureable success, there were still some issues that Mobilization Command (MOBCOM) needed to address regarding providing ready Marines from the IRR into active status including "show" rates, delay, deferment, exemptions, medical and legal issues, and the processes involved in returning massive amounts of Marines to active duty. Ultimately, the paper concluded that

> Time degrades the effectiveness of the IRR during prolonged conflict…the optimal time to mobilize the IRR is in the beginning of a conflict, rather than waiting until the end, because as time progresses, the IRR weakens, the "stronger," (less deployed) Marines discharge, only to be replaced by the same group of Marines that bore the brunt of the major deployments WITHOUT the mobilization of the IRR. In keeping with the Total Force concept, and upon partial mobilization of the reserves, the IRR should be considered a viable source of manpower.[21]

Once again, these findings support the claims from both the Hattiangadi and Schumacher studies that the longer one stays in the IRR, the less likely they are to re-affiliate with any subcomponent of the SMCR. But to a larger extent, the Shinskie study

[21] S.L. Shinskie, Reassessing the Ready Reserves Role in the Marine Corps Total Force. Quantico, VA. (2008).

explores the deeper issue of using the IRR as a more operational force, or what this thesis is addressing and finding ways to get individuals to affiliate as needed.

6. Forecasting United States Marine Corps Selected Reserve End Strength

In this NPS thesis (2010), Emery develops a manpower model forecasting SMCR end strength by forecasting losses with an exponential smoothing model. This model was referenced in Chapter I as the one currently used by the Reserve Affairs (RA) office at Headquarters Marine Corps (HQMC) in Quantico. This new model creates predictions closer to actual strength numbers than the previous model, as measured by standard deviations and range. The model to be developed in this research could feasibly be used in conjunction with the model developed by Emery in forecasting the affiliation and participation end strength levels.

IV. DATA, METHODOLOGY, AND RESULTS

This chapter provides an overview of the data used and the methodology behind building the estimated affiliation and grade strength reference table based on historical data. It discusses the source of the variables, describes the variables themselves and how they are used to create the desired model.

A. DATA

1. Source

As with a majority of the data in this research, the Total Force Data Warehouse (TFDW) system provides the historical data used in building the proposed model. TFDW is a restricted system of the Manpower Information Technology Branch of Manpower and Reserve Affairs (M&RA). It is the official system of the Marine Corps manpower reporting and maintains over 30 years of historical data. Specifically, pay and personnel data are entered daily into the Marine Corps Total Force System (MCTFS), and uploaded each month into TFDW to give the monthly snapshot of the Total Force.

2. Raw Data

The raw data collected consists of 124,086 individual records. Each record represents one field grade officer for that particular period. Each period of time, or sequence, represents a six-month period from 1 October to 31 March and 1 April to 30 September of each fiscal year (FY). The data in this research expands from March 1995 to September 2010 with a missing un-recorded sequence for FY96. Therefore, thirty sequences, at roughly 4,100 individuals per sequence (8,200 individuals per year for fourteen years), are captured.

The data from TFDW consists of 44 variables and input into STATA for merging. The following are the summary statistics from the raw data for the variables that are determined to be more relevant. Table 8 shows the summary statistics for the raw data after merging in STATA.

sum					
Variable	Obs	Mean	Std. Dev.	Min	Max
ima	124086	0.25	0.43	0	1
irr	124086	0.32	0.47	0	1
smcr	124086	0.33	0.47	0	1
asl	124086	0.01	0.07	0	1
lsl	124086	0.09	0.29	0	1
mob	124086	0.12	0.33	0	1
maj	124086	0.58	0.49	0	1
ltcol	124086	0.31	0.46	0	1
col	124086	0.11	0.31	0	1
affiliation	112728	0.64	0.48	0	1
participation	112728	0.94	0.24	0	1

Table 8. Summary Statistics of the Raw Data

Table 8 shows the summary statistics for the three field grade ranks, the summary statistics for the entire Reserve Active Status List (RASL) and the Inactive Status List (ISL), and the average affiliation and participation rates over 112,728 observations. The mean represents the percentage of the total observations that fall within that category. For instance, it shows that 11 percent of the observations were Colonels, 25 percent of the individual records belonged in the Individual Mobilization Augment (IMA) program during that particular sequence, and that over time, the average Selected Marine Corps Reserve (SMCR) affiliation rate among all ranks was 64 percent. It also shows that 12 percent were mobilized at any point in time.

Table 9 shows the first row of the raw data displayed as one individual record. This particular record shows an encrypted identifier (id) with a corresponding sequence number (seq) which represents the sequence date of 31 March 1995. The binary value of zero means “no”, that it does not apply, and the binary value of one means “yes”, that it did apply to that individual at that time. The reserve component code (rcompcode) KA represents SMCR where it is given a binary variable of “1.” This individual is a

Lieutenant Colonel (O-5) and is also affiliated (aff) with the SMCR and has satisfactory participation (part) for this period of time, all of which were given a binary variable of "1."

id	seq	seq_date	rcompcode	grade	billet	ima	irr	smcr	asl	isl	maj	ltcol	col	aff	part
2263	93	31-Mar-95	KA	O5	CO	0	0	1	0	0	0	1	0	1	1

Table 9. Raw Data Output From STATA

3. Preliminary Analysis

Seven variables are constructed from a summary of the raw data set and used to determine historical trends to build the affiliation rate, participation rate and grade strength reference table. Recall that affiliation rates refer to individual Marine officers assigned to an SMCR unit, or in the IMA program. Non-affiliated refers to those enrolled in the Individual Ready Reserve (IRR) or on the Active Status List (ASL) in the Standby Reserve. Moreover, the participation rate refers to those meeting minimum annual requirements. Participation rate data, however, is unavailable prior to FY02, so all participation rate data will refer to FY02 to present. The seven variables used are:

- The Reserve Active Status List (RASL) inventory
- The number of affiliated officers in the RASL
- The affiliation rate
- The number of officers in the RASL maintaining minimum participation
- The total participation rate
- The number of non-affiliated officers in the RASL
- The non-affiliated participation rate

Figures 9, 10, and 11 plot the RASL, affiliation rate, total participation rate, and non-affiliated participation rate for each grade. The graphs support the claim that there is an inverse relationship between changes in inventory and changes in affiliation rates, i.e., an increase in inventory decreases the affiliation rate, as discussed in Chapter II. The

graphs represent the affiliation and participation rates, and RASL inventory. For the purposes of consistency, because participation data is not available prior to FY02, the data on these graphs is limited to FY02 to present for affiliation rates as well. (Read the rates from the secondary Y-axis on the right). The X-axis values represent the sequence dates 31 March 2002 through 30 September 2010 in six-month increments.

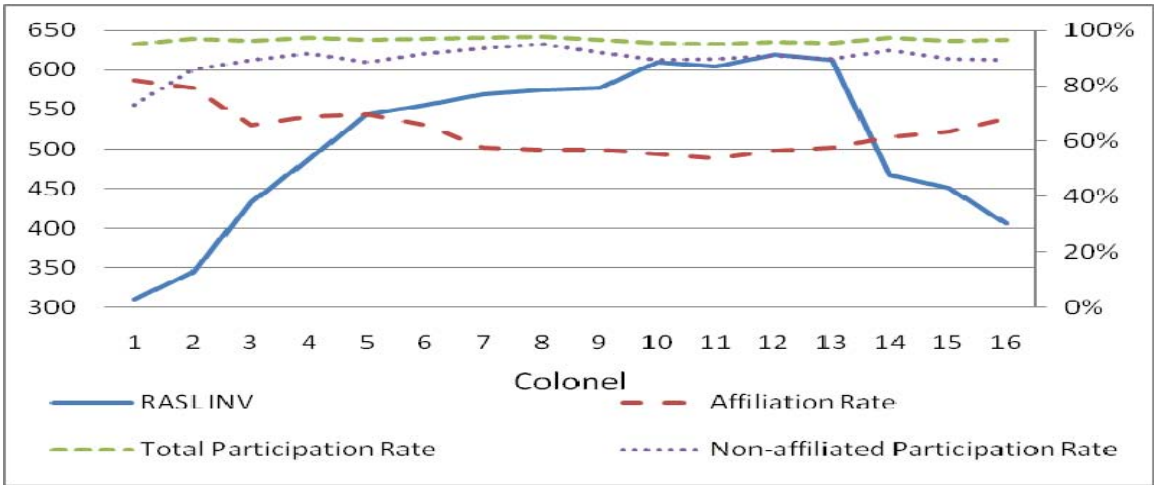


Figure 9. FY02 to FY10 Colonel Inventory, Affiliation and Participation Rates

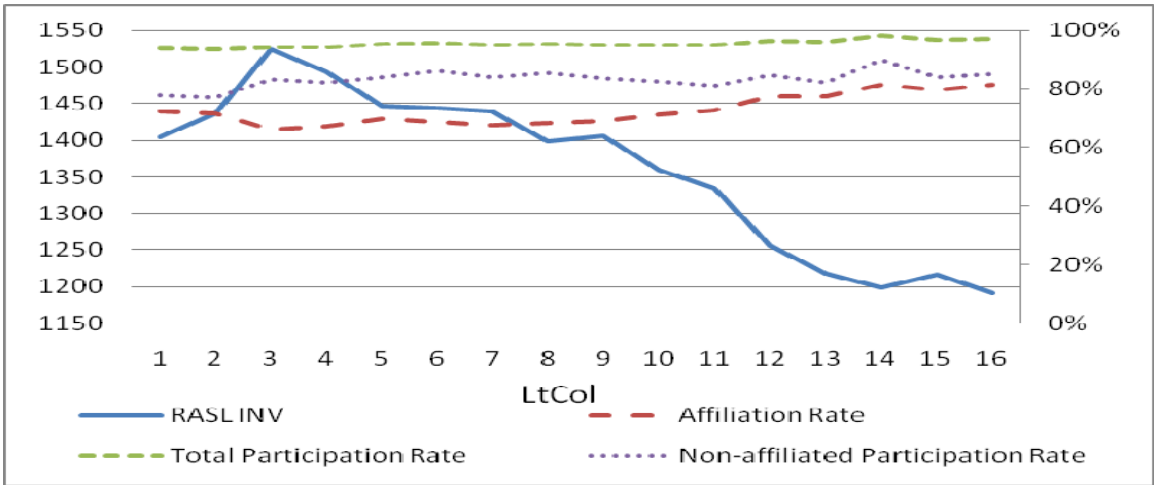


Figure 10. FY02 to FY10 Lieutenant Colonel Inventory, Affiliation and Participation Rates

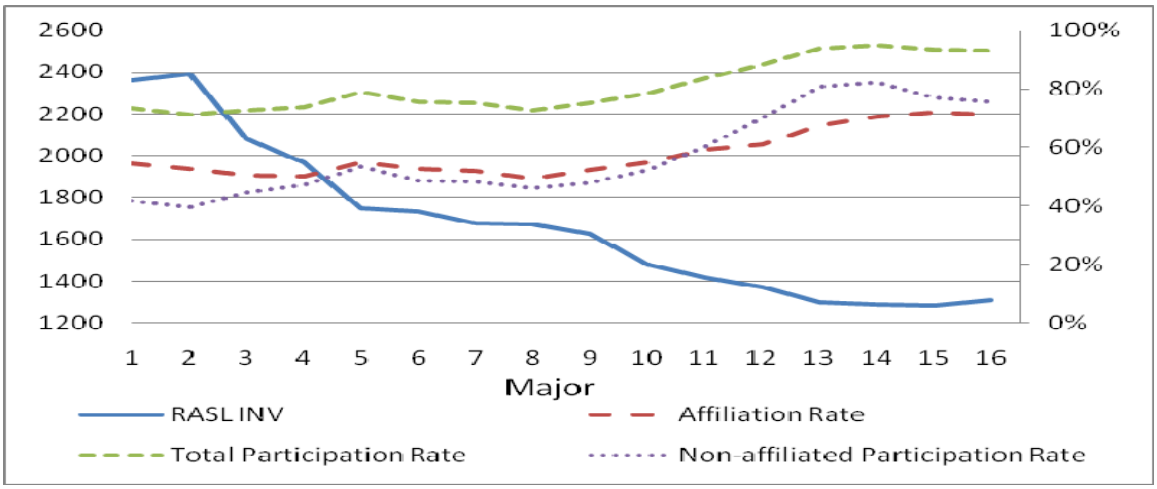


Figure 11. FY02 to FY10 Major Inventory, Affiliation and Participation Rates

Note the total participation rates for Colonel and Lieutenant Colonel range consistently between 92 and 98 percent, while Major total participation rates did not hit the 90s until sequence 12 (end FY08). These graphs show that not being affiliated with an SMCR unit or the IMA generally make it more difficult to acquire the minimum 27 participation points, and more so to acquire the 50 retirement points annually as individuals need to seek out ways to accumulate points via methods previously mentioned. Majors account for a large majority of the IRR force and therefore are the largest contributor to the overall participation rate for field grade officers. Due to the large IRR population, the non-affiliated participation rates drive the overall rate down.

B. METHODOLOGY

1. Ordinary Least Squares Regression

Manpower and Reserve Affairs (M&RA) desires to have a tool to reference grade strength with corresponding estimated affiliations and participants to assist in planning for requirements and potential mobilizations. Using ordinary least squares (OLS) regression with data from the last fifteen years (not including FY96) of RASL inventory and affiliated officers of each rank, a table was created by which a user can locate a desired number of affiliations needed to fill requirements with a corresponding grade strength needed to be maintained in the RASL inventory. However, because of the high

dependence between grade strength levels and time, using simple OLS regression on a time series data set typically results in highly autocorrelated residuals; meaning, there is too much similarity between observations as a function of the time between them.

There are five fundamental assumptions of OLS, three of which apply to the creation of these tables. They are normal residuals, constant variance, and no autocorrelation between the error terms. Therefore, validity of a table based on simple OLS regression cannot be guaranteed if that regression yields autocorrelation. The result, then, from simple OLS regression is a descriptive model based on historical data, rather than a predictive model. However, there was no autocorrelation in the resulting tables for Colonel affiliation and participation, and Lieutenant Colonel participation, therefore resulting in a fit model using simple OLS regression.

OLS models that result in autocorrelated errors require a method known as the Cochrane-Orcutt procedure. (See Appendix A for a step-by-step explanation of this method.) This procedure adjusts the model for autocorrelation and ultimately eliminates autocorrelation and satisfies the three OLS assumptions. This was the case in the resulting tables for Lieutenant Colonel affiliation, Major affiliation, and participation.

C. RESULTS

The result of the OLS regressions yields six tables; an affiliation and participation reference table for each of the three field grade ranks based on available historical data. Table 10 reveals a sample of the Colonel reference table followed by detailed instructions on how it is used. All the tables are presented in smaller RASL inventory increments and in their entirety to allow for more flexibility in analysis in Appendix B. The computing statistics from Excel and the JMP program are presented in Appendix C.

Colonel Affiliation			Colonel Participation	
RASL Inv	Estimated Affiliations	Non-affiliated RASL Inv	Non-affiliated RASL Inv	Estimated Non-Affiliated Participants
290	244	46	50	41
300	248	52	60	50
310	251	59	70	59
320	254	66	80	69
330	258	72	90	78
340	261	79	100	87
350	264	86	110	97
360	268	92	120	106
370	271	99	130	116
380	274	106	140	125
390	278	112	150	134
400	281	119	160	144
410	284	126	170	153
420	288	132	180	163
430	291	139	190	172
440	294	146	200	181
450	298	152	210	191
460	301	159	220	200

Table 10. Summary Table of Colonel Estimates

The Colonel Affiliation table on the left shows that when RASL inventory has "x" number of officers, we can expect "y" number of affiliates to fulfill requirements. Likewise, the Colonel Participation table on the right shows that when we have "x" number of non-affiliated Colonels in the RASL inventory, we can expect "y" number of Colonels sufficiently participating. The following are two basic examples on how to use the tables presented in Table 10.

Scenario 1: Suppose there is a peacetime requirement of 280 Colonels. Therefore, there is a need to have 280 Colonels affiliated with the SELRES to fill billets. By using the "Colonel Affiliation" chart on the left, a user can locate the number closest to 280 in the "Estimated Affiliations" column. The corresponding number in the "RASL Inv" column on the left is equal to 400. This means that around 400 Colonels are needed on the RASL inventory to meet 280 requirements. The difference between the two numbers is equal to 119, which represents the non-affiliated Colonels that come with a RASL inventory of 400.

Now suppose there is a mobilization requirement of 80 unaffiliated participating Colonels (un-funded billets). By locating the number closest to 80 in the "Estimated Non-Affiliated Participants" column on the "Colonel Participation" chart on the right, a user can see that number corresponds to a requirement of 90 in the "Non-Affiliated RASL Inv" column on the left. However, since the initial RASL inventory that was found already included a remainder of 119 un-affiliated Colonels, that inventory of 400 also satisfies the un-funded, non-affiliated mobilization requirement of 80 Colonels, since only 90 unaffiliated are required for the 80 participants. Thus, according to the table, the RASL inventory required to give the desired 280 funded, and 80 un-funded Colonels should be 400.

Scenario 2: Suppose there is a peacetime requirement of 250 Colonels. Therefore, there is a need to have 250 Colonels affiliated with the SELRES to fill billets. By using the "Colonel Affiliation" chart on the left, a user can locate the number closest to 250 in the "Estimated Affiliations" column. The corresponding number in the "RASL Inv" column on the left is equal to 310. This means that around 310 Colonels are needed on the RASL inventory to meet 250 requirements. The difference between the two numbers is equal to 59, which represents the non-affiliated Colonels that come with a RASL inventory of 310.

Now suppose there is a mobilization requirement of 70 unaffiliated participating Colonels (un-funded billets). By locating the number closest to 70 in the "Estimated Non-Affiliated Participants" column on the "Colonel Participation" chart on the right, a user can see that number corresponds to a requirement of 80 in the "Non-Affiliated RASL Inv" column on the left. Since the initial RASL inventory that was found only included a remainder of 59 un-affiliated Colonels, that inventory of 310 does not satisfy the un-funded, non-affiliated mobilization requirement.

In order to make up this deficiency the user must refer back to the Affiliation table and find the next RASL inventory that satisfies a requirement of both 250 affiliated and 70 unaffiliated billets. That value is equal to 340 on the RASL inventory, as 340 includes a difference of 79 unaffiliated Colonels (or close enough to 80). Therefore, the

result according to the table is that the RASL inventory required to give the desired 250 funded, and 70 un-funded Colonels should be 340.

D. LIMITATIONS

There are three issues that contribute most to the limitations of these tables. The first is the lack of data over two very different periods of time. While 14 years of data in some circumstances may seem sufficient, it makes it difficult in the case of pre-9/11 and post-9/11 affiliation and participation behaviors and patterns in the Marine Corps Reserve due to the differences in mobilization requirements during those periods of time.

The second is that due to the close relationship between end strength and time, making large changes in the actual grade-strength based on significant jumps on the table from year to year may not yield ideal results. For instance, to reduce the Colonel RASL inventory from 370 to 310 within a year, it is unlikely that the estimated affiliated number would follow suit with the reference table within a short period of time.

The third is the range of data. In the case of OLS regression based on historical data, the tables cannot be extended to lower or higher inventory levels before the estimated values become skewed. For instance, the historical Colonel RASL inventory minimum is 297 Colonels. To extend the table to lower minimums, by the time the RASL inventory shows 220, the corresponding estimated affiliation is equal to 221, which is impossible. The difference continues to grow further down the table. The user would have to extrapolate any estimation outside the historical range.

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V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

This thesis researches and analyzes the issues surrounding post-9/11 Reserve Component (RC) field grade officer requirements and inventory levels, the history behind the current state of the inventory, and the policy documentation that governs inventory levels. A manpower model is developed to aid the Reserve Affairs (RA) branch in determining Reserve Active Status List (RASL) inventory requirements to meet both peacetime and mobilization requirements based on 15 years of historical inventory, affiliation and participation data.

The data shows that the overall grade strength level is well under budgeted authorizations and discusses how the post-Desert Storm draw down resulted in low augmentation and selection rates. These factors led to the influx of company grade officers into the RC which caused an excess of field grade officers as they promoted through the system. It reviews the inverse relationship between RC growth and Active Component (AC) growth as well as the high operational tempo over the past ten years that caused an increase in senior leadership during the post-9/11 period.

The research discusses in relative detail the reserve structure, the grade strength associated with the Selected Reserve (SELRES) and the field grade population among the entire RASL. The concept of "affiliation" and maintaining the minimum requirements for participation is shown to affect the efficiency in the RC. The research finds that positive relationships between high operational tempo and retention up to a point of diminishing return where the burden became too high and that there are proportional relationships between the AC and RC budgets. A limited amount of previous research has been conducted regarding field grade specific, and none on affiliation specific issues.

The analysis of the raw data from the previous 15 years confirms the inverse relationship between RASL inventory and affiliation and participation rates. It demonstrates how Ordinary Least Squares (OLS) regression is the most accurate way of creating a reference table based on a limited number of historical data sequences and how

the Cochrane-Orcutt procedure remedies the issue of autocorrelation between time and grade strength levels. The results are three comprehensive tables for each of the three field grade ranks by which a user can determine projected affiliation and participation levels with a pre-determined level of RASL inventory.

B. CONCLUSIONS AND RECOMMENDATIONS

1. What Inventory Does the Marine Corps Require For Reserve Field Grade Officers in the Post-9/11 Era to Maintain Acceptable Affiliation and Participation Levels in Accordance With Tables of Organization (T/O) and Mobilization Requirements?

a. Conclusion

M&RA monitors and maintains desired affiliation and participation levels of field grade officers in the RC. The affiliation and participation inventory tables created in this research is a statistically accurate tool to monitor these levels. The tables are based on Ordinary Least Squares (OLS) regression on 15 years of historical data, and assist the user in determining the appropriate levels of inventory to meet pre-determined affiliation and participation levels to meet peacetime and mobilization requirements.

b. Recommendations

Recommend M&RA collect more data each fiscal year in order to regularly adjust and recalculate the affiliation and participation reference tables to account for the most recent inventory, affiliation, and participation levels. The accuracy of the tables will validate each fiscal year based on actual affiliation and participation levels as a function of RASL inventory.

2. Is the Number of Reserve Component Field Grade Officers Currently Over or Undermanned?

a. Conclusion

The analysis shows that field grade inventories are all significantly lower than the RASL authorization. The SELRES inventory levels are all less than the SELRES Table of Organization (T/O) requirements and below the Authorized Strength Report (ASR) limitations, with the exception of an excess of 216 Lieutenant Colonels

above ASR limitations. All three field grade ranks meet the minimum standard participation rates if the desired rate is 90 percent or better for total participation. However, the non-affiliated participation rates creep below 90 percent for Lieutenant Colonels and under 80 percent for Majors.

b. Recommendations

Recommend RA consider reducing the excess inventory of Lieutenant Colonels in the SELRES, many of whom may be on their way to getting promoted. According to historical trends, reducing the non-affiliated inventory would increase the non-affiliated participation rates for Lieutenant Colonel and Major. In particular, the trend within the rank of Major is that as the non-affiliated RASL inventory increases, the non-affiliated participation rate drops dramatically. It is also recommended that RA reduce the size of the IRR and the SELRES T/O to meet current requirements based on current inventory and funding levels.

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APPENDIX A. COCHRANE-ORCUTT PROCEDURE

One of the fundamental assumptions of Ordinary Least Squares regression is that the error terms are uncorrelated. OLS models that yield autocorrelated errors require a treatment known as the Cochrane-Orcutt procedure.
Such models have the following structure:

$$Y_t = \beta_0 + \beta_1 X_t + \varepsilon_t$$
$$\varepsilon_t = \rho \varepsilon_{t-1} + u_t$$

Where:

ρ is a parameter such that $|\rho| < 1$
u_t are independent $N(0,\sigma^2)$

This model is identical to the traditional OLS model except for the fact that it includes the autoregressive nature of the error terms.

The following is a step-by-step outline for performing the Cochrane-Orcutt procedure as a remedial measure for autocorrelated errors in OLS regression.

Step 1: **Estimate ρ**

Fit the original Ordinary Least Squares model. As part of the validation for any OLS model it is necessary to measure the extent to which the errors are correlated with one another. Suppose, as with several of the models developed in this thesis, that the errors exhibit significant positive correlation at lag 1. We can estimate ρ with the following formula:

$$r = \frac{\sum_{t=2}^{n} e_{t-1} e_t}{\sum_{t=2}^{n} e_{t-1}^2}$$

Step 2: **Fit Transformed Model**

Transform the X and Y variables as follows:

$$Y_t' = Y_t - \rho Y_{t-1}$$
$$X_t' = X_t - \rho X_{t-1}$$

using the ρ from the previous step.

Fit a new OLS regression to obtain the following model:

$$\hat{Y}' = b_0' + b_1' X'$$

Step 3: **Test for Autocorrelation**

Test again for autocorrelation.

We now have an OLS model with uncorrelated errors. Transform the fitted model back into the original variables as follows:

$$b_0 = \frac{b_0'}{1 - \rho}$$
$$b_1 = b_1'$$

which yields the following fitted regression line in the original variables:

$$\hat{Y} = b_0 + b_1 X$$

APPENDIX B. COMPLETE TABLES

Colonel Affiliation

RASL Inv	Estimated Affiliations	Non-affiliated RASL Inv
290	244	46
300	248	52
310	251	59
320	254	66
330	258	72
340	261	79
350	264	86
360	268	92
370	271	99
380	274	106
390	278	112
400	281	119
410	284	126
420	288	132
430	291	139
440	294	146
450	298	152
460	301	159
470	304	166
480	308	172
490	311	179
500	314	186
510	318	192
520	321	199
530	324	206
540	328	212
550	331	219
560	334	226
570	338	232
580	341	239
590	344	246
600	348	252
610	351	259
620	354	266

Colonel Participation

Non-affiliated RASL Inv	Estimated Non-Affiliated Participants
50	41
60	50
70	59
80	69
90	78
100	87
110	97
120	106
130	116
140	125
150	134
160	144
170	153
180	163
190	172
200	181
210	191
220	200
230	209
240	219
250	228
260	238
270	247
280	256

LtCol Affiliation			LtCol Participation	
RASL Inv	**Estimated Affiliations**	**Non-Affiliated RASL Inv**	**Non-Affiliated RASL Inv**	**Estimated Non-Affiliated Participants**
725	700	25	210	177
750	711	39	220	185
775	723	52	230	193
800	734	66	240	201
825	745	80	250	210
850	756	94	260	218
875	768	107	270	226
900	779	121	280	234
925	790	135	290	242
950	801	149	300	250
975	813	162	310	259
1000	824	176	320	267
1025	835	190	330	275
1050	847	203	340	283
1075	858	217	350	291
1100	869	231	360	299
1125	880	245	370	308
1150	892	258	380	316
1175	903	272	390	324
1200	914	286	400	332
1225	925	300	410	340
1250	937	313	420	348
1275	948	327	430	357
1300	959	341	440	365
1325	970	355	450	373
1350	982	368	460	381
1375	993	382	470	389
1400	1004	396	480	397
1425	1016	409	490	406
1450	1027	423	500	414
1475	1038	437	510	422
1500	1049	451	520	430
1525	1061	464		
1550	1072	478		

	Major Affiliation		Major Participation	
RASL Inv	**Estimated Affiliations**	**Non-Affiliated RASL Inv**	**Non-Affiliated RASL Inv**	**Estimated Non-Affiliated Participants**
1200	810	390	350	300
1250	835	415	375	305
1300	860	440	400	311
1350	884	466	425	316
1400	909	491	450	321
1450	934	516	475	326
1500	959	541	500	332
1550	983	567	525	337
1600	1008	592	550	342
1650	1033	617	575	348
1700	1057	643	600	353
1750	1082	668	625	358
1800	1107	693	650	363
1850	1132	718	675	369
1900	1156	744	700	374
1950	1181	769	725	379
2000	1206	794	750	385
2050	1230	820	775	390
2100	1255	845	800	395
2150	1280	870	825	400
2200	1305	895	850	406
2250	1329	921	875	411
2300	1354	946	900	416
2350	1379	971	925	422
2400	1403	997	950	427
2450	1428	1022	975	432
2500	1453	1047	1000	437
2550	1478	1072	1025	443
2600	1502	1098	1050	448
2650	1527	1123	1075	453
2700	1552	1148	1100	459
2750	1576	1174	1125	464
2800	1601	1199	1150	469
2850	1626	1224		
2900	1651	1249		

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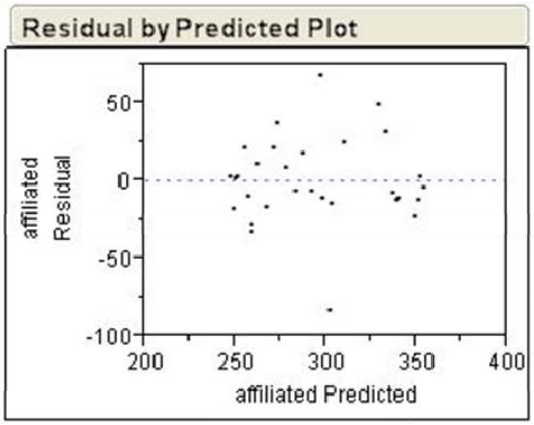
APPENDIX C. REGRESSION RESULTS

Raw regression results for Colonel affiliation from JMP statistical software:

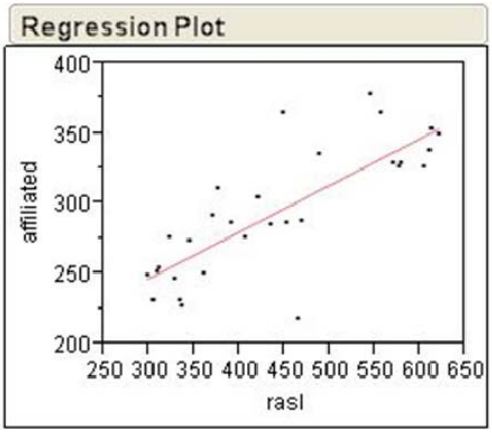


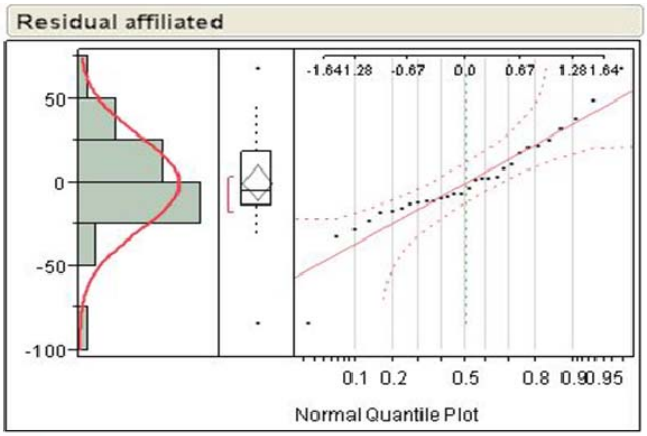
Summary of Fit

RSquare	0.632419
RSquare Adj	0.619291
Root Mean Square Error	28.43805
Mean of Response	294.4333
Observations (or Sum Wgts)	30

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	147.60804	21.78203	6.78	<.0001*
rasl	0.3333403	0.048027	6.94	<.0001*



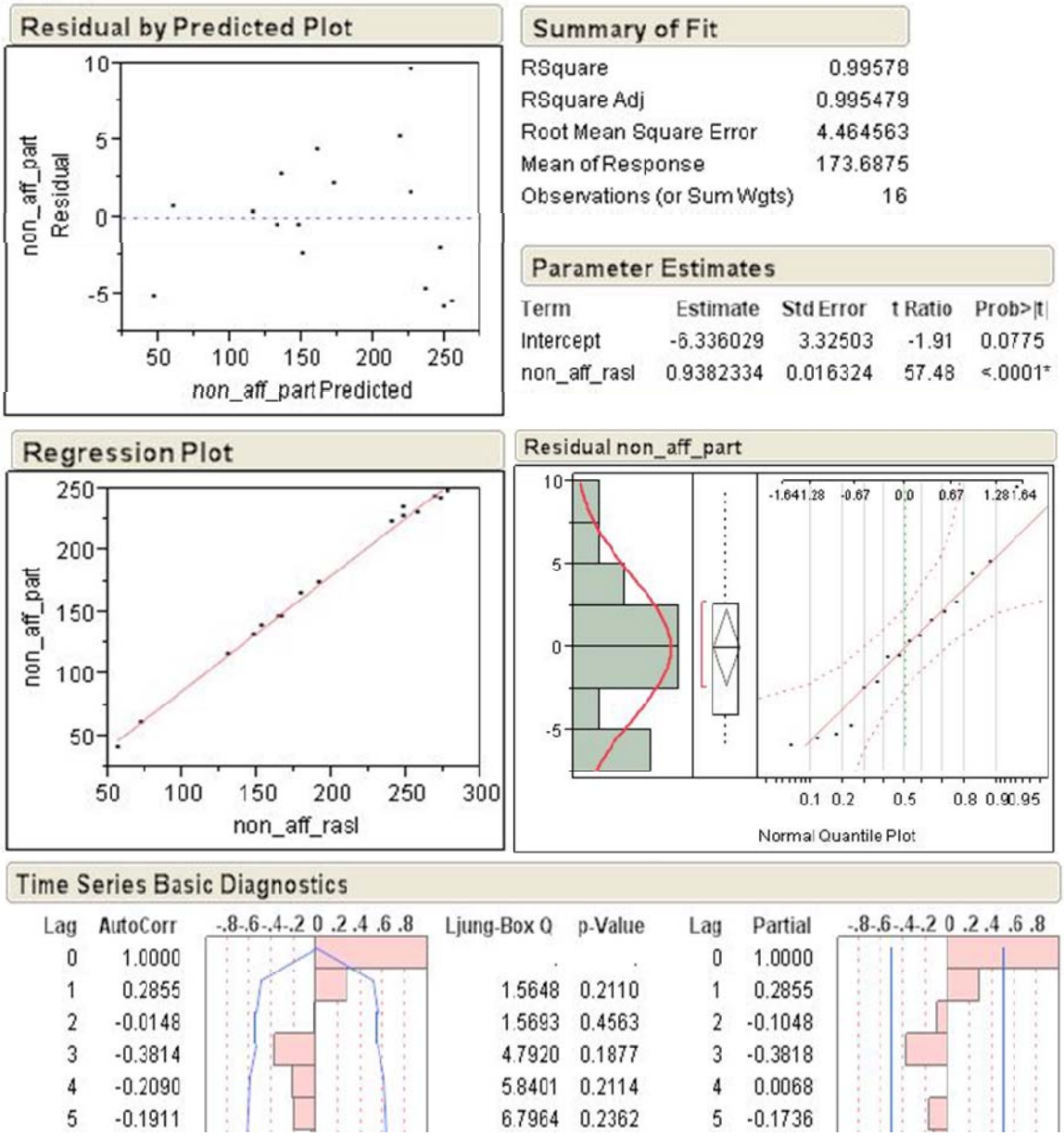


Time Series Basic Diagnostics

Lag	AutoCorr	Ljung-Box Q	p-Value	Lag	Partial
0	1.0000	.	.	0	1.0000
1	0.1231	0.5019	0.4787	1	0.1231
2	-0.0308	0.5344	0.7655	2	-0.0466
3	-0.1673	1.5296	0.6755	3	-0.1604
4	-0.0415	1.5931	0.8100	4	-0.0023
5	-0.0579	1.7219	0.8861	5	-0.0646

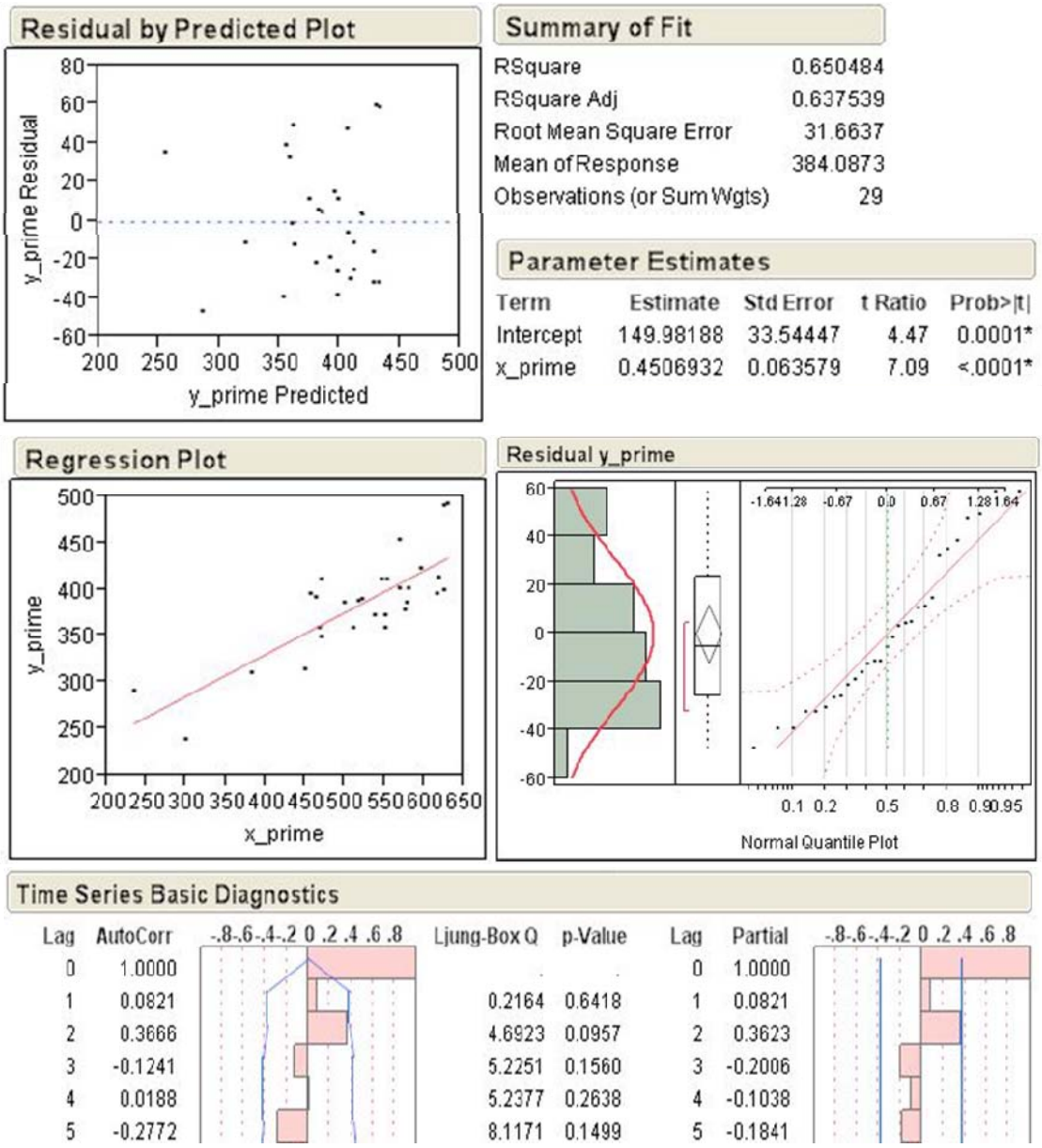
Initial Colonel regressions yielded no autocorrelation so no transformation was required. The results show constant variance and normally distributed residuals. The R Squared is high. The Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) show no autocorrelation.

Raw regression results for Colonel participation from JMP statistical software:



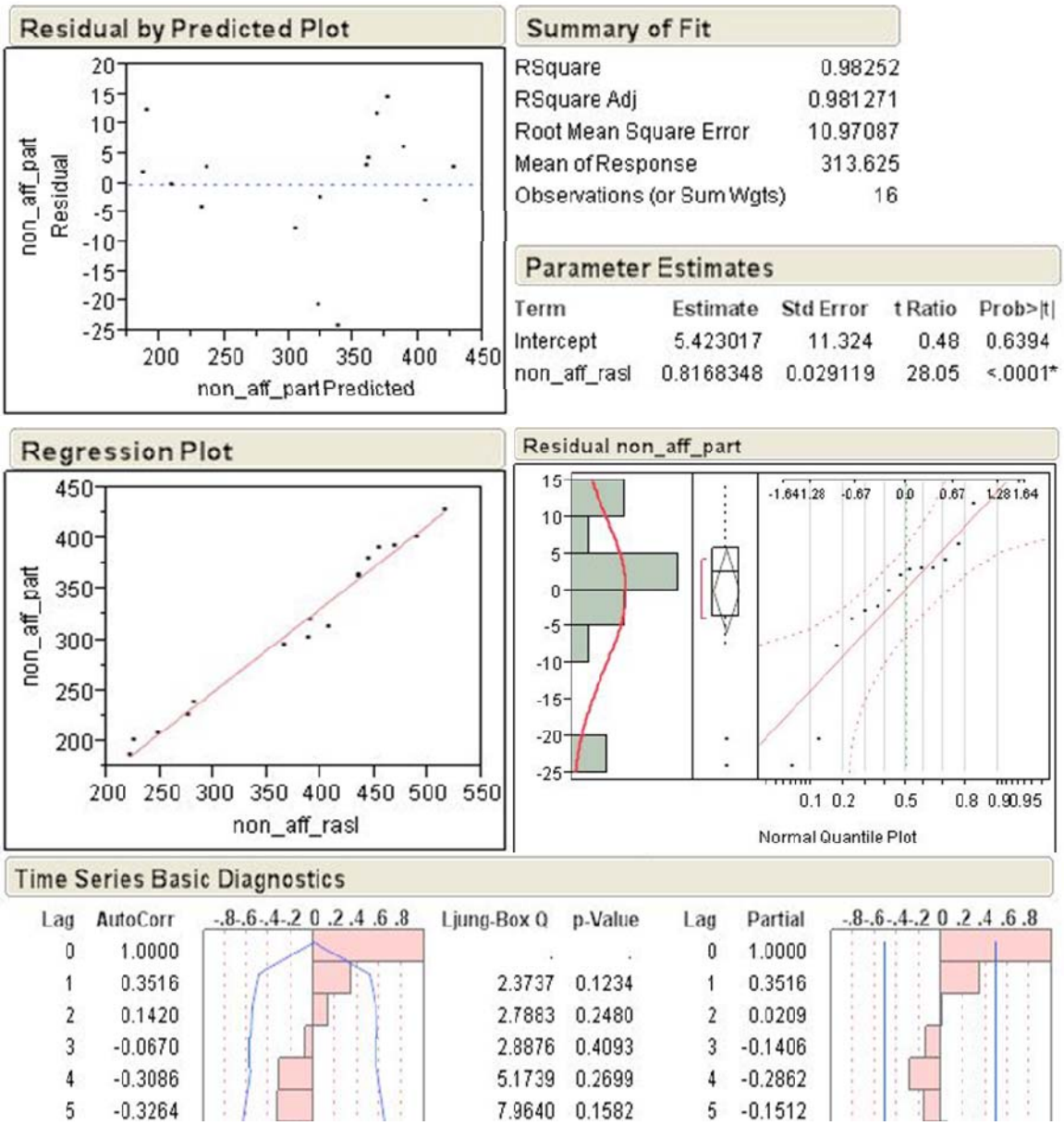
The results show constant variance and are fairly normally distributed residuals. The R Squared is very high. The ACF and PACF show no autocorrelation.

Raw regression results for Lieutenant Colonel affiliation from JMP statistical software:



Lieutenant Colonel initial regression results on affiliation yielded autocorrelation, so transformation to x-prime and y-prime was necessary. The results show constant variance and normally distributed residuals. The R Squared is high. The ACF and PACF show no autocorrelation but are marginal at Lag 2.

Raw regression results for Lieutenant Colonel participation from JMP statistical software:



Lieutenant Colonel initial regression results on participation yielded no autocorrelation, so transformation to x-prime and y-prime was not necessary. The results show constant variance and are normally distributed with the exception of a couple outliers. The R Squared is very high. The ACF and PACF show no autocorrelation.

The following are the raw Excel results for Lieutenant Colonel un-transformed participation, and transformed Lieutenant Colonel affiliation to give an example of how the final tables were derived.

Raw regression results from Excel for Lieutenant Colonel participation:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.991
R Square	0.983
Adjusted R Square	0.981
Standard Error	10.971
Observations	16

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	94712.711	94712.711	786.912	0.000
Residual	14	1685.039	120.360		
Total	15	96397.750			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	**5.423**	11.324	0.479	0.639	-18.865	29.711
X Variable 1	**0.817**	0.029	28.052	0.000	0.754	0.879

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	322.355	-20.355
2	337.058	-24.058
3	426.093	2.907
4	404.855	-2.855
5	360.746	4.254
6	376.266	14.734
7	387.702	6.298
8	368.098	11.902
9	359.929	3.071
10	323.172	-2.172
11	303.568	-7.568
12	234.954	3.046
13	230.869	-3.869
14	188.394	12.606
15	207.998	0.002
16	185.944	2.056

PROBABILITY OUTPUT

Percentile	*Y*
3.125	188
9.375	201
15.625	208
21.875	227
28.125	238
34.375	296
40.625	302
46.875	313
53.125	321
59.375	363
65.625	365
71.875	380
78.125	391
84.375	394
90.625	402
96.875	429

seq_date	maj	non_aff _rasl	non_aff _part	Non-Affiliated RASL Inv	b0.hat + b1.hat * RASL Inv Estimated Non-Affiliated Participants
34789	**2495**	**388**	**302**	**210**	**177**
34972	**2904**	**406**	**313**	**220**	**185**
35885	**2790**	**515**	**429**	**230**	**193**
36068	**2653**	**489**	**402**	**240**	**201**
36250	**2616**	**435**	**365**	**250**	**210**
36433	**2622**	**454**	**391**	**260**	**218**
36616	**2503**	**468**	**394**	**270**	**226**

The errors are uncorrelated. So, this is the appropriate relationship.

Fit regression: non_aff_part = B0 + B1*non_aff_rasl

b0.hat	b1.hat
5.423	**0.817**

Raw non-transformed regression results for Lieutenant Colonel affiliation:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.922
R Square	0.850
Adjusted R Square	0.844
Standard Error	59.765
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	565155.878	565155.878	158.225	0.000
Residual	28	100011.989	3571.857		
Total	29	665167.867			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	**124.727**	63.866	1.953	0.061	-6.096	255.550
X Variable 1	**0.627**	0.050	12.579	0.000	0.525	0.730

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	663.002	-176.002
2	593.365	-11.365
3	644.808	14.192
4	623.478	8.522
5	768.398	-18.398
6	791.610	-29.610
7	818.587	-13.587
8	934.648	39.352
9	929.002	11.998
10	962.879	54.121
11	968.526	50.474
12	1021.224	78.776
13	1006.167	10.833
14	1025.615	4.385
15	1050.710	-38.710
16	1066.394	-48.394
17	1080.823	-71.823
18	1061.375	-57.375
19	1031.889	-20.889
20	1030.634	-40.634
21	1027.498	-56.498
22	1001.776	-47.776
23	1006.795	-34.795
24	977.309	-7.309
25	962.252	7.748
26	912.691	62.309
27	888.851	53.149
28	876.931	98.069
29	888.224	80.776
30	872.540	98.460

PROBABILITY OUTPUT

Percentile	*Y*
1.667	487
5	582
8.333	632
11.667	659
15	750
18.333	762
21.667	805
25	941
28.333	942
31.667	954
35	969
38.333	970
41.667	970
45	971
48.333	971
51.667	972
55	974
58.333	975
61.667	975
65	990
68.333	1004
71.667	1009
75	1011
78.333	1012
81.667	1017
85	1017
88.333	1018
91.667	1019
95	1030
98.333	1100

Once it is determined that autocorrelation exists, it is necessary to measure the extent to which the errors are correlated with one another by estimating r.

	e(t)	e(t-1)	e(t-1)e(t)	e(t-1)^2
1	-176.002			
2	-11.365	-176.002	2000.203	30976.564
3	14.192	-11.365	-161.286	129.156
4	8.522	14.192	120.943	201.408
5	-18.398	8.522	-156.789	72.625
6	-29.610	-18.398	544.771	338.487
7	-13.587	-29.610	402.309	876.771
8	39.352	-13.587	-534.663	184.601
9	11.998	39.352	472.139	1548.556
10	54.121	11.998	649.334	143.950
11	50.474	54.121	2731.694	2929.030
12	78.776	50.474	3976.166	2547.653
13	10.833	78.776	853.358	6205.670
14	4.385	10.833	47.497	117.347
15	-38.710	4.385	-169.725	19.224
16	-48.394	-38.710	1873.316	1498.451
17	-71.823	-48.394	3475.793	2341.961
18	-57.375	-71.823	4120.845	5158.556
19	-20.889	-57.375	1198.507	3291.884
20	-40.634	-20.889	848.812	436.352
21	-56.498	-40.634	2295.738	1651.148
22	-47.776	-56.498	2699.213	3191.970
23	-34.795	-47.776	1662.342	2282.525
24	-7.309	-34.795	254.306	1210.668
25	7.748	-7.309	-56.627	53.418
26	62.309	7.748	482.765	60.030
27	53.149	62.309	3311.673	3882.447
28	98.069	53.149	5212.252	2824.811
29	80.776	98.069	7921.634	9617.485
30	98.460	80.776	7953.259	6524.812
		Sum =	54029.779	90317.559
			r =	**0.598**

Once r is found, transform x and y into x' and y', then a new regression is performed to provide new intercepts:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.80652598
R Square	0.65048416
Adjusted R Square	0.63753913
Standard Error	31.66369921
Observations	29

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	50379.857	50379.857	50.250	0.000
Residual	27	27069.926	1002.590		
Total	28	77449.783			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	**149.982**	**33.544**	4.471	0.000	81.154	218.809
X Variable 1	**0.451**	**0.064**	7.089	0.000	0.320	0.581

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	255.329	35.348
2	322.212	-11.364
3	284.781	-46.995
4	398.057	-26.120
5	352.454	-39.104
6	361.859	-12.687
7	433.644	58.805
8	379.711	-21.358
9	406.475	47.619
10	395.972	14.658
11	431.404	59.030
12	397.941	-38.961
13	418.383	3.248
14	428.053	-32.199
15	428.536	-15.914
16	432.162	-32.129
17	411.989	-11.573
18	399.164	11.243
19	410.935	-25.715
20	409.220	-30.438

PROBABILITY OUTPUT

Percentile	*Y*
1.724	237.786
5.172	290.677
8.621	310.848
12.069	313.350
15.517	349.172
18.966	358.353
22.414	358.755
25.862	358.980
29.310	371.938
32.759	373.148
36.207	378.782
39.655	385.220
43.103	385.755
46.552	388.550
50.000	389.746
53.448	391.344
56.897	394.746
60.345	395.854
63.793	400.032
67.241	400.416

The variables can be transformed to fit the new OLS regression resulting in the new table (in bold):

rasl	affiliated	x_prime	y_prime	RASL	b0.hat + b1.hat * RASL Inv Est_Affiliated	b0'_hat/(1-r) B_hat_0	B_hat_1
858	**487**			**750**	**711.300**	373.275	0.451
747	**582**	233.744	290.677	**780**	**724.821**	373.275	0.451
829	**659**	382.145	310.848	**810**	**738.342**	373.275	0.451
795	**632**	299.092	237.786	**840**	**751.863**	373.275	0.451
1026	**750**	550.431	371.938	**870**	**765.384**	373.275	0.451
1063	**762**	449.247	313.350	**900**	**778.905**	373.275	0.451
1106	**805**	470.113	349.172	**930**	**792.426**	373.275	0.451
1291	**974**	629.391	492.449	**960**	**805.947**	373.275	0.451
1282	**941**	509.724	358.353	**990**	**819.468**	373.275	0.451
1336	**1017**	569.108	454.094	**1020**	**832.989**	373.275	0.451
1345	**1019**	545.805	410.631	**1050**	**846.510**	373.275	0.451
1429	**1100**	624.421	490.434	**1080**	**860.031**	373.275	0.451
1405	**1017**	550.172	358.980	**1110**	**873.552**	373.275	0.451
1436	**1030**	595.529	421.631	**1140**	**887.073**	373.275	0.451
1476	**1012**	616.985	395.854	**1170**	**900.594**	373.275	0.451
1501	**1018**	618.057	412.622	**1200**	**914.115**	373.275	0.451

Fit regression: affiliated = B0 + B1*rasl

b0.hat	b1.hat
124.7	**0.627**

1. Find correlation of residuals at lag 1

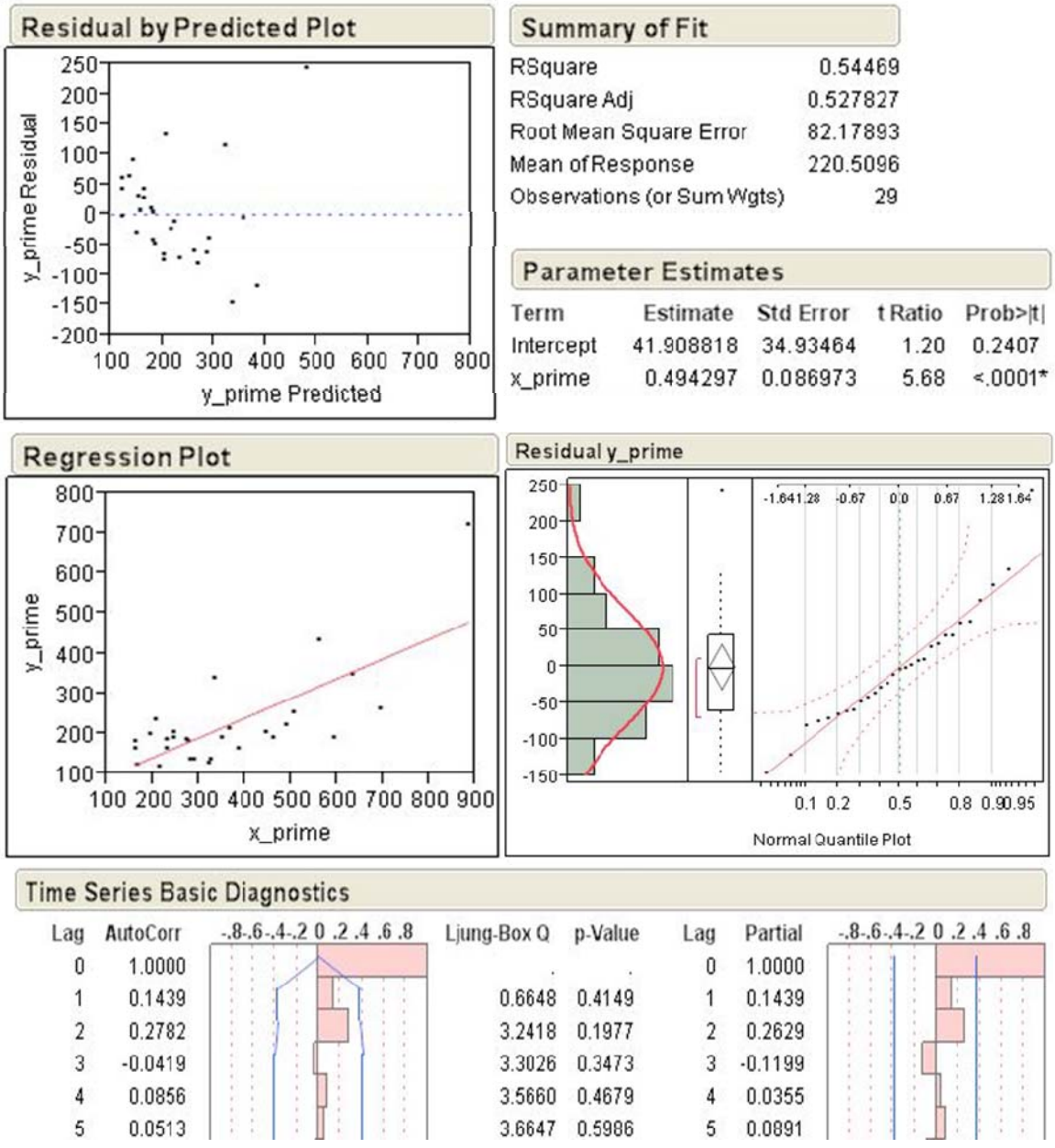
r
0.598

2. Transform

3. Fit regression: y_prime = B0'_hat + B1'_hat*x_prime

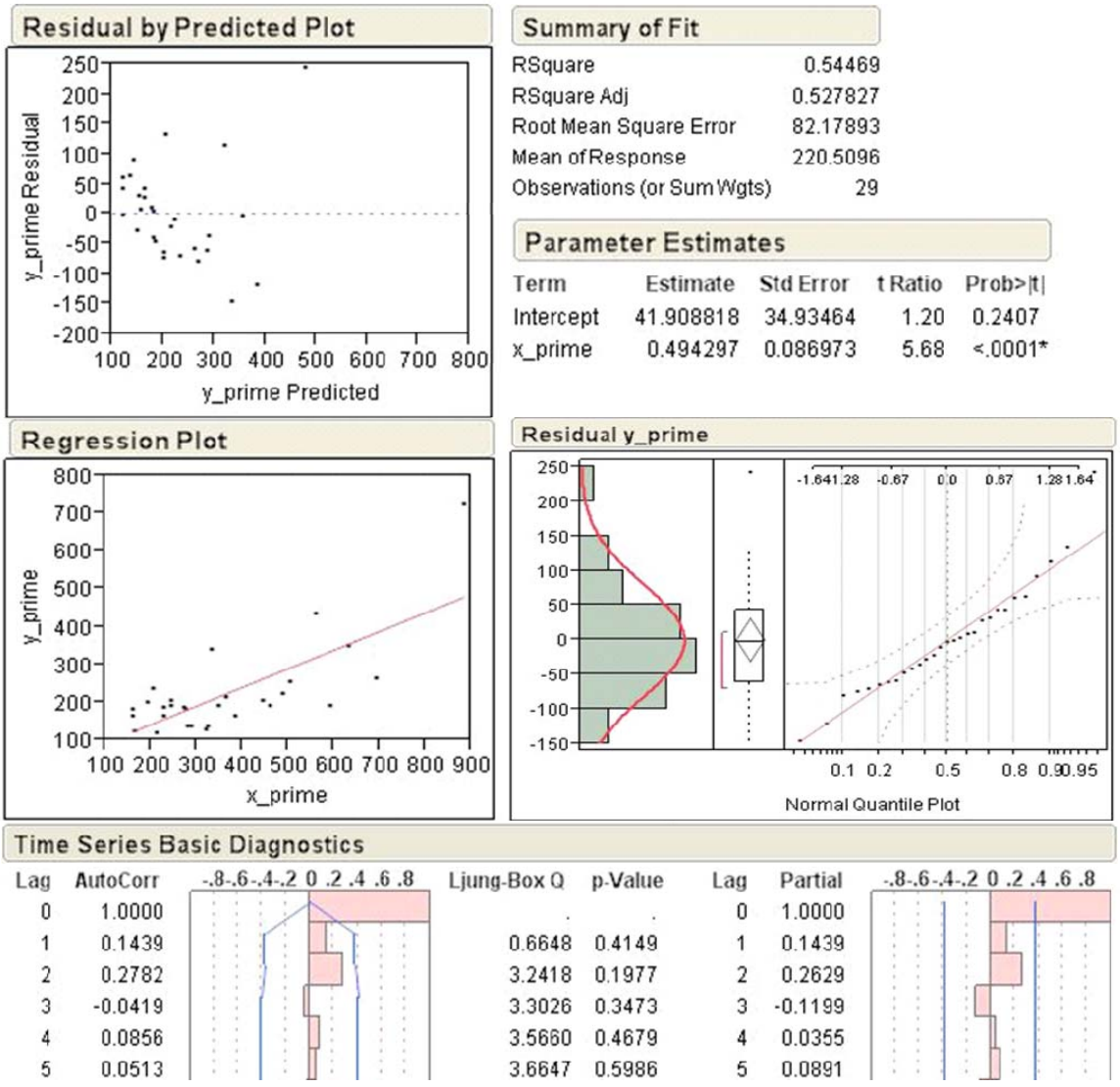
B0'_hat	B1'_hat
149.982	**0.451**

Raw regression results for Major affiliation from JMP statistical software:



Major initial regression results on both affiliation and participation yielded autocorrelation, so transformation to x-prime and y-prime was necessary. The results show constant variance and are normally distributed. The R Squared is relatively high. The ACF and PACF show no autocorrelation.

Raw regression results for Major participation from JMP statistical software:



The results show constant variance and are relatively normally distributed. The R Squared is relatively high. The ACF and PACF show no autocorrelation.

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